DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

EDITED BY A. S. RUSSELL, M.C., D.Sc.

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No. 10. OCTOBER 1920 PRICE 6d. NET

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PUBLISHED BY JOHN MURRAY, 50A ALBEMARLE STREET, LONDON, W.1.

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Edited by A. S. RUSSELL, M.C., D.Sc., 4 Moreton Road, Oxford, to whom all Editorial Communications should be addressed.

Published by JOHN MURRAY, 50A Albemarle Street, London, W.1, to whom all Business Communications should be addressed.

Advertisement Office: 16 Regent Street, London, S.W.1.

Annual Subscription, post free: Inland 8*s.* 6*d.*; Abroad 7*s.* 6*d.* Single numbers 6*d.* net; postage, Inland 2½*d.*; Abroad 1½*d.*

Editorial Notes

THE eighty-eighth meeting of the British Association for the Advancement of Science met in Cardiff this year. The meetings were well attended, and the discussions on the scientific problems which arose were very good ones. This association, as is well known, serves three main purposes: it gives scientific workers an opportunity for getting in touch with men who are working on allied subjects; it endeavours to encourage research in all subjects; it attempts to make scientific knowledge accessible to the general public. The association has a president, always a distinguished man, who commences the proceedings by delivering an address which sets many people thinking and talking for a considerable time after it has been delivered. Thereafter the association breaks up into twelve sections, each of which has a president, addresses, lectures, and discussions. Interspersed with this work are entertainments and excursions, and the general public of the town are treated to five public lectures.

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The president this year was Professor W. A. Herdman, of Liverpool, and the subject of his address was Oceanography. In this address he made two important suggestions: (1) that a department of oceanographic and fisheries research should be established at Cardiff; and (2) that there should be a great national oceanographical expedition, fitted out by the Admiralty, and embracing all departments of the science of the sea—a new *Challenger* expedition, in other words. It is very probable that the second of these will receive the support of the Government, and that not only zoologists, but workers in chemistry, physics, geology, and geography will be among the investigators who go out on that trip. He pointed out that a scientific investigation of the ocean might be considered under two heads, the industrial need and the purely scientific need, and he dealt with both of these in detail. Both needs are very great. There is not a single marine animal, for example, whose mode of life is fully understood. Even common fish, such as the cod and the herring, are in many respects unknown to scientists.

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Of course purely scientific work and investigations with a practical end in view do not allow themselves to be kept separate. At times each is of great assistance to the other, and more especially obvious is the contribution of the purely scientific work to that undertaken for a practical and commercial end. It was an investigation of the warm and cold areas of the Faroe Channel which led to the discovery there of the fishing grounds extensively exploited since by British trawlers. Again, when making a scientific study of the deep-sea deposits, Sir John Murray discovered the valuable deposits of phosphates in Christmas Island. We hope to have an article on the interesting subject of oceanographical research in the next number of this Journal.

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To turn now to the address[1] of Mr. J. McFarlane, the president of the Geographical Section. Mr. McFarlane discussed in some detail the principles upon which the recent territorial rearrangement of Europe has been based. He considers that Europe will be most stable politically when geographical and ethnical conditions are most in harmony, that is when the people of a particular race live as far as possible inside the boundaries of that race's country, and least

[1] I am indebted to *Nature* of August 26 for the basis of these remarks.—ED.

stable when boundaries are settled by considerations other than geographical or ethnical. The pre-war Austrian Empire, for example, was such a mixture of political and economic interests that it was bound to come to grief sooner or later, and at the present time it looks as though there were no place at all for it in the new Europe. Again, Italy's northern boundary before the war was unsatisfactory, because much of what was essentially Italy was in Austrian hands. The war settlement, although it has done much, has not straightened out everything. It has established the state of Poland, and this is justifiable on racial grounds, although the country's position geographically is weak principally because there are no natural boundaries to prevent invasion or to restrain the Poles from wandering beyond the racial limits of their country. It has also transferred Alsace-Lorraine to France, and this is justifiable on the ground that the inhabitants are more in sympathy with the French than with the Germans.

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The treatment of the Hungarian plain, however, is considered to be the most unsatisfactory part of the peace settlement. This is the country of the Magyars, and the partitioning off of parts of it among neighbouring countries is bad, and very likely to lead to trouble in the future. Rumania, for example, by annexing parts of Hungary, has lost her unity of political outlook and her racial homogeneity.

The new state Czecho-Slovakia, which comprises Bohemia, Moravia, and Slovakia, is in many ways the most interesting country in Europe at present. As a whole, however, it is strategically weak, and it does not possess geographical unity. For while Bohemia is geographically individual, and Slovakia strategically strong, Moravia, which unites them, lies across an important route from the Adriatic to the plains of Northern Europe.

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Of those who have attempted to set down in writing, for the benefit of the general public, what Professor Einstein's great theory of relativity [1] is all about, it really looks as if Professor Einstein himself were going to come the nearest to success. As this is something which altogether violates tradition, it is a statement of remarkable importance. The tradition is, of course, that a great scientist must be perfectly unintelligible to all but a favoured few. He can explain the universe, or some part thereof, but no one of the general public can grasp a word of that theory at the time it is proposed. Explanations of the theory, when they come at all, come later. They are not given by the Great Man himself. They are the labour of love of the favoured few. Happily the tradition in this case is violated. In this book it really looks as if Professor Einstein had succeeded.

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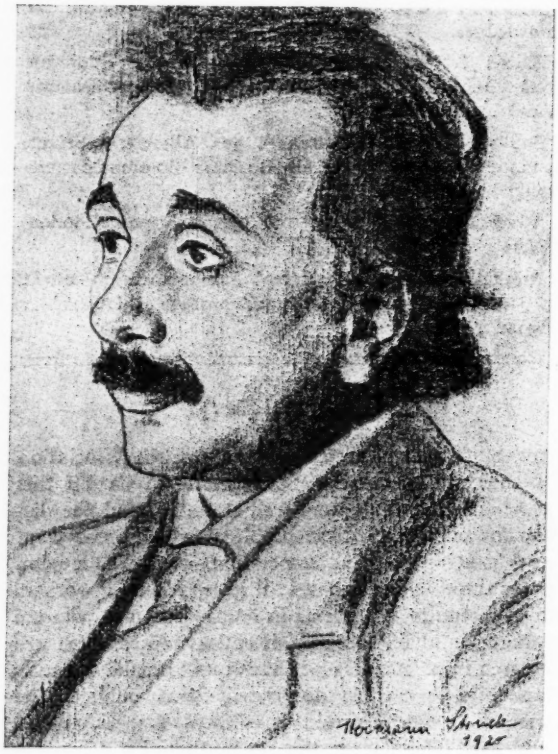
Now the theory of relativity is difficult. All theories are. To understand it really and truly one needs a pretty fair training both in mathematical physics and in philosophy. In addition, a spacious imaginative power, an effort of concentration, and a will-to-understand are not in the way. But the theory is of such importance and interest that an honest



A. EINSTEIN.
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attempt to learn what it is about, even in the most elementary way, should be made. Professor Einstein's book is a tremendous help towards this end. He presumes a standard of education corresponding to that of a university matriculation examination, and despite the book's shortness, a fair amount of patience and force of will on the part of the reader. There is, however, nothing in the mathematics or in the philosophical conceptions which need distress anybody unduly, and I feel sure that anyone who gives the book a decent sitting will have a pretty clear and true conception of relativity.

[1] *Relativity.* The Special and the General Theory. By Professor A. Einstein. Translated by R. W. Lawson, D.Sc. (Methuen, 5*s*.)

This book naturally appeared originally in German, and it is largely due to the enthusiasm of the translator, Dr. Lawson, that the book now appears in English in its present form. Dr. Lawson was doing research on radium in Vienna prior to hostilities, and unfortunately was compelled to remain there during the war, and therefore to miss a good deal of the fun and excitement and food which was the happy lot of most of us elsewhere. But he learned German, and this clear and excellent translation is a testimony to his knowledge of that language. He has got Professor Einstein to add an appendix on the experimental confirmation of the general theory,[1] and he has prefaced the volume with a crayon drawing of the author by a German artist, which we reproduce here.

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It would be madness for me to attempt to say anything about relativity itself in a few paragraphs except just to indicate in broadest outline the general plan of the book. The book begins by explaining clearly the *principle* of relativity, and why it is necessary to accept it. The author then goes on to show that on the old principles of mechanics the law of propagation of light and the principle of relativity are incompatible, and, as there seems to be no clear way out if either is given up, a dilemma arises. The *special theory* of relativity, which does away completely with this dilemma, is then stated and explained by several carefully chosen illustrations, and the hitherto tacit assumption that the statement of time has an absolute significance, i.e. that it is independent of the state of motion of the body of reference, is shown to be incompatible with the most elementary facts. Next the *general theory* of relativity (of which the *special theory* is merely a special case) is introduced and explained, and the amazing result arrived at that, in general, rays of light are propagated curvilinearly in gravitational fields. Considerations on the universe as a whole arising out of the general theory—the possibility of a finite yet unbounded universe, and the general structure of space—perhaps the most interesting part of all, conclude the book.

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A correspondent who is interested in my remarks on "dowsing" last month sends me his experiences. For some time he has acted as sponsor for a man who lives in the same town, who is a thoroughly good dowser. He is quite convinced that this peculiar power is genuine, and is inclined to think it is probably in some way electrical in origin. A real, thorough, scientific investigation of the whole business in a laboratory has not yet been done. Various tests, however, of different kinds and degrees of difficulty have been set the dowser, and metals have been graded as good, bad, and indifferent, according to the amount of "pull" experienced by him at a distance of three feet. It was found that the dowser is sensitive to gold, silver, copper, and zinc, but not to brass, to platinum, or to steel. He is particularly sensitive to nickel. My correspondent further points out that water-dowsing from the scientific point of view is a by-path, for there the phenomenon is studied under conditions needlessly difficult. What is primarily needed is an investigator to collaborate with the dowser in carrying out a series of experiments under definite laboratory conditions, so that methods and apparatus for measuring the amount and distance of the stimulus and the amount of the response can be worked out as a preliminary to a thorough investigation in detail.

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I have since met this dowser myself, and he did several very interesting experiments for me. He is most sensitive to running water (he is not at all sensitive to stagnant water), then to nickel, gold, silver, and copper in decreasing order. He is sensitive also to certain alloys; to bronze, for instance, but not to brass. He can tell quite easily whether you have concealed under a hat a sensitive object like a shilling, or something to which he is insensitive, like a piece of brass or a brick. One of his stunts is to say whether or not water is *running* through the water-pipe at a certain place, and this he can do easily, and apparently infallibly. He can tell whether your safe has any valuables (in metal) in it, and he has succeeded in locating hidden safes by his response to the gold and silver inside of them. He finds, however, that he cannot detect things which are placed above him, and also that the presence of a second sensitive substance at a few feet in a certain direction to another sensitive object inhibits the effect. Apart altogether from the scientific explanation of dowsing, and from its utility in locating underground springs, a demonstration of dowsing makes a first-class parlour entertainment.

[1] See DISCOVERY, February 1920, p. 48.

Was Drake Guilty of Murder?

By Geoffrey Callender

Head of the History Department, R.N. College, Osborne

"A VERY religious man towards God and His houses, generally sparing the churches wherever he came; chaste in his life, just in his dealings, true of his word, and merciful to those that were under him." Such is the character of Francis Drake drawn by Fuller

in his *Worthies*; but it is not an estimate that Spaniards would endorse; and it is a Spanish, rather than a true, portrait of the admiral that our own history-books persistently reproduce. In spite of Sir Julian Corbett's masterly analysis of sixteenth-century international custom respecting maritime reprisals, Drake is still regarded by his own countrymen as a pirate or corsair. Nor is that the end, or the worst, of the indictment. He is accused during the voyage of circumnavigation of emulating the ferocity of Ferdinand Magellan, and under the guise of legal formalities, of murdering his own familiar friend, the accomplished courtier Thomas Doughty.

The voyage of circumnavigation may be thought of as the third canto of what Lope de Vega called the *Dragontea*, or Epic of the "Dragon." Before examining it, however, we must briefly survey the two adventures that preceded it.

Drake made his first bow before a world-wide audience when in 1567–8 he accompanied his kinsman John Hawkins on a trading venture to the Spanish Main. The voyage reached a tragic termination in the Mexican harbour of Vera Cruz, which was then styled San Juan de Ulloa. Here Don Martine Enriquez, Viceroy of New Spain, having given the Englishmen permission to re-equip their ships, basely attempted to sink "without leaving a trace" the helpless vessels he had sworn to protect. And yet, despite his unscrupulous thoroughness, two vessels escaped from the pit of destruction—the *Minion* brought out by Hawkins in person, and the *Judith* by his kinsman Drake.

Hawkins returned to England smarting under his wrongs, and endeavoured at once to procure a royal licence to institute reprisals. But, for reasons which need not be specified here, Elizabeth sternly refused to sanction any scheme of revenge. By enforcing this decision she went a long way towards ending an awkward international situation which Hawkins's voyage had occasioned. It was only by means of letters patent from the Crown that the seizure of Spanish property, as compensation for losses inflicted by Spanish subjects, could by maritime usage have been regularised. The firmness of Elizabeth and her counsellors therefore seemed to bring a painful incident to its close.

But Francis Drake decided otherwise. He resolved to exact from the Spanish Empire complete reparation, even if he had to do so single-handed. Working under a cloak of secrecy, he learnt the Spanish tongue, visited the Spanish West Indian settlements, mixed with his enemies undetected, and discovered all that he needed to know for the schemes that were surging through his brain. He then collected a handful of men, and in a couple of ships set his sails westward-ho for the second eventful chapter of his life. He purposely avoided the baleful shores of Mexico, preferring to exact the restitution he wanted from the harvests of Peru. The treasures of that kingdom (according to his newly bought intelligence) were sent down to the sea from Potosi, Lima, and Quito, and embarked in ships for Panama. Arriving there, they were transferred to *recuas*, or droves of pack-animals, which trotted across to the Atlantic shore, where the glittering commodities were once more re-embarked and conveyed by sea to Spain. There was no traffic through the Strait of Magellan. Every ounce of gold and every uncut emerald passed on mules' backs over the route now followed by the Panama Canal.

Here, then, in bold defiance, Drake stationed himself; and, after hairbreadth adventures which rob romance of its glamour, he ambushed the royal *recuas*, and carried away more wealth than ever figured in an Arabian Night's entertainment. His men filled their bonnets and their boots with gold, then tightened their belts and filled their shirts; and, ere they reached their ships, cast carelessly aside what a king might well have envied. As for the silver, it was nothing accounted of, and was left unregretted beneath the branching coco palms.

Now, whatever may be thought of Drake's conduct on this occasion, there is at least no doubt that in a technical sense he was acting as a pirate; that is to say, he was acting without licence, or letters of marque to cover and legitimise his proceedings. Had the Spaniards caught him, they would have been perfectly justified in delivering him to the familiars of the Holy Office, or hanging him on the nearest tree. Nor did Drake's peril end when he once more dropped anchor at Plymouth. The Spanish representative at the Court of St. James's could easily find out whether Elizabeth had sanctioned the enterprise; and if she had not done so, custom entitled his countrymen to the body of the malefactor. Whether Elizabeth would yield to Spanish pressure and surrender one of her subjects was a doubtful question likely to turn on the exigencies of the moment. The name of Drake was still quite obscure, and the Queen had expressly forbidden any reprisals for what had happened in Mexico. Drake was a man who hardly knew the meaning of fear; but he was not one to accept foolhardy risks. On his return from the Isthmian adventure, he disappeared, and remained in hiding until the storm which he had brewed had somewhat spent its force.

Meanwhile he cherished in his memory the Pisgah-sight which he had seen from the mountains overlooking Panama. Under the guidance of a native chieftain, a *cacique* of the Cimaroons, he had climbed to a platform built in a high tree, and had felt his breath come quickly as he had seen for the first time

the league-long glories of the shimmering Pacific. Descending from the eyrie, he had kneeled upon the ground, and prayed God to give him life and strength to drive a furrow through those mighty waters. All with him had been carried away by his enthusiasm; and his second officer, John Oxenham, had clasped him by the hand, and vowed to follow him.

This John Oxenham, so well known to lovers of Kingsley's famous book, is a picturesque and pathetic figure. It was Drake who had put him in mind to sail on the Pacific; and he would have acted more wisely if he had waited a while, until Drake gave the signal to start. Oxenham did not do so. In 1575, three years after the great raid, he set out again for the Isthmus independently. He hid his ship, crossed the mountains unobserved, and set to work in the recesses of the forest to fashion the sort of craft he now required. When she was finished, he floated her successfully down a river, and launched her on the wide Pacific. Good fortune rewarded his toil. Near the Isle of Pearls he captured two barques from the Peruvian port of Quito. The prisoners were many; the spoil was great. Nothing remained but to elude the Spaniards, and carry the treasure home. But Oxenham, with all his courage, lacked the gift of leadership. He allowed his enemies to see which course he was taking; he failed to keep his own men under control. Even his allies, the Cimaroons (who had followed Drake with the fidelity of dogs), turned against him and betrayed him. The few genuine details which survive in the pages of Purchas and Richard Hawkins have been worked up by Kingsley into a highly coloured, but not improbable, narrative. The whole expedition ended tragically; and the Spaniards no doubt felt that they were avenged for the losses which Drake had inflicted three years before. They inquired carefully (this fact should be borne in mind) whether Oxenham had any licence or letters patent from the Queen; and when he failed to produce any, they took summary vengeance. Five boys were spared on account of their youth, and probably sold into captivity. The remainder were executed in batches at Panama; all except Oxenham himself, his master and pilot. The *Dictionary of National Biography* tells us that these three unhappy men were conveyed to Lima, and hanged there the same year. But this information (as will presently be shown), though derived from the best Elizabethan sources, is none the less incorrect.

Towards the close of 1577 Drake set out on his third adventure—the voyage of circumnavigation. Not that his plans at starting involved a circuit of the globe. What he proposed was to penetrate into the Pacific (as he had promised himself in Darien), and return again, if Providence permitted, by whatever route seemed to offer the best chance. There is no need to linger over the details of his programme once the Pacific was reached. It was the spirit of adventure that actuated him; and to this he doubtless added the expectation of further reprisals, and perhaps a faint hope that he would be able to find an entirely new route to the Indies.

Oxenham had reached the Pacific by way of Darien; but Drake proposed to utilise the Strait of Magellan. This sounds a simple enough project to-day, but in 1577 the attempt was one which none but the boldest would consider. Sebastian Cabot had attempted to force the Strait, and failed. Amerigo Vespucci could not even find it. Del Cano, who brought home the remnants of Magellan's expedition, found the passage again with Loaysa in 1525; but neither Loaysa nor Del Cano returned alive. Henceforth the mysterious water-gate could not have been more religiously avoided if it had been the portals of Dante's Inferno. The tortuous passage beyond the gate was known to be 450 miles long, with inhospitable precipices on either hand, and baffling airs that held a ship captive. In the language of the time it was said to be the link between the "North Sea," the ocean of the Old World, and the "South Sea," the ocean of the New. In its swirling eddies, it was thought, the waters of the Atlantic and the waters of the Pacific found their only point of contact. Above the Strait was the great land-mass improperly christened after Amerigo; and below it, stretching away to the "Pole Antartick," lay the corresponding mass of an imaginary continent, *Terra Australis Nondum Cognita.*

All this Drake knew and faced without quailing. Like Ulysses of old, he was cheerfully prepared to go down to the mouth of Hades. But it was another matter to induce ignorant and superstitious mariners to follow him: and he did not consider his preparations complete until he had persuaded some of the best gentlemen in the land to join his company and leaven the lump. Of noble volunteers by far the most important was Thomas Doughty, whose bravery, learning, and charm of manner endeared him to Drake above all who volunteered.

It was vitally important to keep the Spaniards in ignorance of what was afoot; for a hint of Drake's scheme would enable them to post a fleet at one end of Magellan's Strait, and deny him all ingress into the Pacific. Drake himself was a past-master of the art of camouflage; and, when at last he set sail from Plymouth, it was nominally for the harbour of Alexandria to pick up a cargo of currants. The Spaniards grew suspicious, and, interpreting the move as a mission to rescue or avenge John Oxenham, took every precaution that suggested itself in the Isthmus of Panama.

Drake's voyage to the South Pacific was without

incident until the Cape Verde Islands were reached. But here joy and sorrow came hand in hand. In the first place Drake captured a Portuguese pilot, Nuño da Silva, whose knowledge of the coasts of South America, and willingness to accompany the English expedition, justified something like real confidence in eventual success. But in the second place, Thomas Doughty, whom Drake had treated as a brother, suddenly threw off disguise and revealed the cloven hoof. No one has been able to discover with exactness what motives were at work in Doughty's breast. It is difficult to believe that he was in Spanish pay, though treachery of that kind was not unknown even in the highest circles. It is more likely that the ambitious youngster had been won over by the advocates of peace, who feared that the maritime schemes of Drake would lead to a definite rupture with Spain. Whatever his motives, there is no doubt at all that, from the Cape Verdes onwards, Doughty did his utmost to frustrate the ends of the voyage. Drake treated him at first with the tenderness he would have shown to a naughty child; but when delinquencies were multiplied, he grew stern and severe, and on one occasion had Doughty bound to the mast. It was not, however, until the mischief wrought by this propagandist had spread from one ship to another, infecting with its poison the whole confraternity, that Drake felt compelled to end his golden project or the life of the man he had loved.

He was not long in deciding. Anchoring his ships in St. Julian's Bay on the coast of Patagonia, he brought Doughty to trial before a court composed of his brother-officers. The prisoner was accused of plotting to frustrate the objects of the voyage; and upon an overwhelming show of evidence was found guilty. Drake then assembled every man who served under him; and, after explaining the case in full assembly, passed sentence of immediate death. Froude has given currency to a tale that Drake himself acted as executioner[1]; but the story is traceable to a tainted Spanish source, and there is sufficient evidence in the English documents to prove the contrary. But that Doughty was decapitated, and died at Drake's bidding, are facts beyond all dispute.

And the question that immediately arises is this: By what authority did Drake sentence to death the most influential personage of all who sailed with him? If it could be established by incontrovertible proofs that Drake had been given no delegated power, then we should have to admit that the charge of judicial murder had not unjustly been laid at his door. But what proof has ever been adduced except the wrangling recriminations of excited partisans? Modern experts have based their opinions on admittedly indirect evidence; and this should be carefully borne in mind when their pronouncements are examined.

Sir Julian Corbett, in his comprehensive work on this period,[2] writing in 1898, says: "It is almost certain that Drake had no express authority to inflict capital punishment." Sir John Laughton goes further. In his Life of Drake in the *Dictionary of National Biography*, after showing how the audacious raider of Darien was introduced by Sir Christopher Hatton into the presence of Elizabeth and was permitted to recount some of his experiences, he continues: "It is probable enough that she received him graciously. His adventures, his daring, his success, were so many passports to her favour, and there is no reason to doubt that, in ambiguous and courtly phrases, she encouraged him to further enterprise; but it is in the highest degree unlikely that, before a stranger to her court, she laid aside her dissimulation and gave a formal commission for reprisals to a man whose repute was that of an unscrupulous adventurer. Such a commission could not have been kept secret, and would have been considered by Spain as tantamount to a declaration of war. Still less can we accept the story that, knowing, as she certainly did know, that he was proposing a voyage which must bring him into conflict with the Spaniards, she said to him, 'I account that he who striketh thee, Drake, striketh me.' Any such speech, if possible—and it is not Elizabethan in its sound—could only have been uttered at a much later period, and most probably in reference to private rather than to public enemies."

There are in this expression of opinion points which detract from its value. We know now that sixteenth-century Governments were accustomed to witness the depredations of licensed corsairs without allowing themselves to be drawn into open warfare. We do not know whether such a roving commission could or could not have been kept secret. The reported speech may or may not carry an Elizabethan sound, but it comes from the authentic narrative of Master Francis Fletcher, chaplain on board the *Golden Hind*.[3] Furthermore, it is logically inadmissible to refer to Drake as an "unscrupulous adventurer," when he is standing his trial in a land where men are held innocent until they are proved guilty. Yet Sir John Laughton is not the most prejudiced of Drake's prosecutors. Those who desire to read a more thorough-paced indictment should turn to Mr. David Hannay's denunciation in the pages of *Ships and Men*.

It must be confessed that among books published

[1] *History of England*, vol. xi, p. 127.

[2] *Drake and the Tudor Navy*, vol. i, p. 235 note.

[3] "We do account that he which striketh at thee, Drake, striketh at us": *The World Encompassed by Sir Francis Drake*. This work, first published in 1626, is based on Fletcher's original notes, which are in the British Museum, Sloane MSS., No. 61.

before the outbreak of the recent war there is little to comfort those who, studying the life of Drake as a whole, and finding it morally wholesome, have refused to believe that grapes grow on thorns, or figs on thistles. Happily, however, since the summer of 1914, some vital discoveries have been made public which set the whole question in an entirely new light.

The first of these we owe to Mrs. Zelia Nuttall, a student of Mexican archæology almost as well known on this side of the Atlantic as on the other. She was, she tells us, some years ago making researches in the National Archives of Mexico, and examining Inquisition trials for Aztec practices, when chance led her to a dust-covered volume lying on the floor. She carried it to a window to see what it was, and, turning over its leaves, came across the "Declaration by Nuño da Silva as to how he was taken prisoner by English pirates on his way from Oporto to Brazil, May 23, 1579." An anxious and excited scrutiny soon revealed the name of "Francisco Drac"; and, under the compelling charm which that name has ever exercised, Mrs. Nuttall tossed aside her Aztec pursuits, and followed up a clue which led her in turn to New York, Simancas, Seville, Madrid, Rome, London, and Oxford.

The first revelation that closely concerns us was contributed by the archives of Seville. But before examining it, we shall do well to take the circumnavigator over another reach of his voyage.

After the execution of Doughty, Drake pushed on; and, with forces meekly submissive to his leadership, and unanimous in their respect to his authority, entered the Strait of Magellan. In seventeen days the passage perilous was passed, and the little fleet entered the Pacific. There they experienced the most terrible weather, and through this the *Golden Hind* alone emerged with limbs unbroken and resolution unshattered. The *Marygold* was devoured by the wolfish waves; and the *Elizabeth* returned through the Strait to England. Drake, with a brain of ice and a heart of fire, explored the seas that threatened to engulf him, and discovered the rolling expanse of oceans to the south of Tierra del Fuego. This momentous discovery supplied him with a homeward route alternative to Magellan's Strait, and, with spirit reinforced by joy and gladness, he ran northward into Spanish domains. At Valparaiso, Arica, and Tarapaca, he ballasted his ship with golden ingots; and on February 13, 1579, with delightful insouciance dropped anchor amongst the native craft in the harbour of Lima. He was almost immediately detected as an alien corsair, and the hue and cry was raised. The Viceroy of Peru mustered every citizen that could fight, and ordered ships to be prepared for their embarkation. The word "Inglese"[1] was passed from mouth to mouth, and then the blood-curdling hiss, "El Draque!"

But the Viceroy was uncertain who the intruder could be, or where his vessel could hail from. He therefore gave orders to Juan Gutierrez de Ulloa (Chief Clerk of the Holy Office) to examine (with the usual rites) three Englishmen still imprisoned at Lima in the cells of the Inquisition. These were no other than John Oxenham, his pilot, and his master; and their depositions, dated February 20, 1579, constitute the fortunate find that Mrs. Nuttall has made in the archives of the Indies at Seville.[1]

Oxenham's testimony (when translated) runs as follows:

"Questioned whether, while in England or since he had left there, he had heard or understood that Queen Elizabeth or any other person had entertained the project to arm a certain number of vessels for the purpose of establishing settlements, or for other purposes, on the coast of the 'North Sea,' or in the region of the Strait of Magellan, or on the coast of the 'South Sea,' he answered that four years ago an English knight named Richard Grenville, who lives at a distance of a league and a half from Plymouth, and is very rich, applied to the Queen for a licence to come to the Strait of Magellan and to pass to the 'South Sea,' in order to search for land or some islands where to found settlements, because in England there are many inhabitants and but little land. The Queen gave him the licence and witness saw it. It was very large (*muy grande*). The said Grenville bought two ships, and was about to buy two or three more, when the Queen revoked the licence because she had learnt that beyond the Strait of Magellan there were settlements made by Spaniards, who might do them harm. The said Grenville sold the ships after the licence had been taken from him. Previously to that, he had spoken many times with witness, trying to persuade him to accompany him, but witness did not wish to do so. Grenville's project was to come and found a settlement on the River Plate, and then pass the Strait and establish settlements wherever a good country for such could be found.

"Witness thinks that if the Queen were to give a licence to Captain Francis Drake, he would certainly come and pass through the Strait, because he is a very good mariner and pilot, and there is no better one than he in England who could accomplish this. Witness thinks that the Queen will not, as long as she lives, grant the licence, but that after the Queen's death, there will certainly be someone who will come to the Strait. The said Captain Francis had often spoken to witness saying that, if the Queen would grant him

[1] *Archivo General de Indias*, E1, C1, L4-1, No. 32.

the licence, he would pass through the Strait of Magellan and found settlements over here in some good country."

Thomas Butler, the pilot, gave evidence which need not be quoted in full. It confirms in the most striking way all Oxenham's chief points. Witness reasserted the Queen's unwillingness to plant colonies where the Spaniards had already founded settlements; but saw in this no reason for the abandonment of Grenville's scheme, only a cause for modifying the projected itinerary. He restated his emphatic belief that no Englishman would dare to pass the Straits of Magellan without the Queen's express permission; and added that Grenville had been obliged to abandon his enterprise because Elizabeth demanded a deposit of £40,000 as guarantee that he would not interfere with Philip's oversea dominions. In conclusion, he found no reason to believe that Drake would attempt that in which Grenville had failed; for the undertaking required a leader of the highest rank, and the Plymouth seaman was mean and obscure.

The master, whose name the Spaniards wrote down as Xervel or Xerores, had little to add to what the other two had said. He confirmed their testimony, especially in regard to the Queen's grip upon all seafarers and their plans; and, though himself had served with Drake in the Isthmian Raid of 1572, he dismissed contemptuously the idea that a Plymouth seaman would gain the succession to Richard Grenville.

This body of evidence, given by men who had been absent from England since 1575, and who spoke under the shadow of death and without any knowledge that Drake, their own captain, was near them, make three things, I think, abundantly clear, viz.:

(1) That within a short time of Drake's return from his Pisgah-sight on the Darien peak (August 9, 1573), Richard Grenville, the greatest magnate in the West Country, applied to the Crown for permission to penetrate by Magellan's Strait to the Pacific.

(2) That a licence of the most far-reaching kind was granted to him for this purpose: and, after preparations had been made, was revoked.

(3) That Oxenham (the only one of the witnesses who would be of a status to be consulted by principals) had refused to visit the Pacific with Grenville by way of Magellan's Strait; but knew that Drake was anxious to do so if the licence, once revoked, could by any means be reissued.

All this fits in with established facts. We know that Grenville enjoyed great influence at Court, and was foremost in the support of all sea-causes. We know of no trait more characteristic in Elizabeth than the grant of a permit for some audacious scheme, and the cancelling of the same at the very last moment. We know that Oxenham had chosen his own route to the Pacific, which was the path of plunder rather than of enterprise. And we know how fervently Drake cherished in his heart his desire to furrow the Pacific with an English keel.

The most striking fact, however, that emerges is this: that Grenville's lordly seizure of Drake's idea, and prematurely impetuous exploitation of the same, made Elizabeth herself the guardian of Magellan's Strait. Drake might reach the Pacific as Oxenham had reached it, or take it in reverse by the Cape of Good Hope; but if he ventured from the "North" Sea into the "South," he would need a renewal of Grenville's letters patent.

Mrs. Nuttall's researches were published in the summer of 1914, and the process of Drake's rehabilitation, which seemed almost completed by her palæographic skill, halted till the recent war was nearing its end.

On July 25, 1917, Mr. R. Pearse Chope, of the Patent Office, read to the Devonshire Association, then meeting at Barnstaple, a valuable paper which has been printed in their *Transactions* under the title "New Light on Sir Richard Grenville."

Basing his researches upon the evidence of Oxenham and his companions already given, Mr. Chope has unearthed the complete Grenville dossier, including the memorial to the Crown craving the necessary permission; a concurrent petition (as we should have expected) to the Lord High Admiral; a dissertation on the objects and advantages of the expedition; and, last but not least, the original draft of the letters patent that Oxenham described.[1] Mr. Chope has conducted his work with commendable patience and skill, bridging the pitfalls with which previous investigators had trenched the road to truth. The documents which he prints (when taken in the mass) add a new vista to our knowledge of the indomitable Sir Richard. But in the present inquiry the letters patent alone concern us. They are, as the Inquisitors learnt from John Oxenham, *muy grande*, which I take to mean "of the most far-reaching description." They are certainly too voluminous to quote *in extenso*. It must suffice to quote that portion which deals with the Crown's delegation of authority, curtailing somewhat (for clearness' sake) the copious legal verbiage:

"Forasmuch as no good enterprise can be prosperously performed without unity and good agreement of such as take the same in hand, which unity and agreement cannot be performed without authority in the Governors and due obedience in the multitude, know ye that of our special grace, certain knowledge, and mere motion we have given and granted . . . to the said Richard Grenville . . . full power and autho-

[1] The date of these documents is 1574.

rity to rule and govern all such persons and every of them as shall be retained or go in the said voyage according to such laws, rules, ordinances as by the said Richard Grenville . . . shall for that purpose be made; straitly charging all our subjects that shall be retained to go in the said voyage to be obedient unto all the said laws . . . as . . . abovesaid, on pain not only of our high indignation, but also of such pains and executions as by the said laws . . . be limited, and on pain if they shall be found obstinately disobedient, or forsake the said voyage, or flee from the said governance . . . upon their return into any of our dominions to be executed and put to pains of death as open rebels by martial law without mercy, remission, or favour.

"And of our further special grace . . . we give, grant . . . to our said . . . Richard Grenville full power and authority that it shall be lawful . . . to make and establish laws and ordinances and to limit pains and penalties both pecuniary, corporal, and capital, and of death, or otherwise howsoever, for the governance of such as shall pass in the said voyage; together with power . . . to rule and govern and make ordinances by discretion as occasion shall fall out, although such ordinances be not before expressly written and declared. And . . . it shall be lawful to the said Richard Grenville . . . all the said laws and ordinances to use, practise, and execute; and the offenders thereof (according to the said laws and ordinances) to punish and correct: and all the persons of the said company rebelliously or obstinately resisting . . . to punish with death or otherwise to punish with pains of death, or otherwise correct without other judicial proceedings but by the Law Martial according to discretion. And all pains and executions of death so to be done and inflicted shall be accompted and judged lawfully done as by our special will and commandment . . . and by force of our most high and absolute prerogative Royal, and as upon rebels against our Estate, Crown and Dignity. For so it is our will and pleasure."

Here, then, we find Elizabeth granting to the first projector of the Pacific Exploration Scheme absolute powers of life and death over all who sailed with him. And it requires no straining of the evidence to argue that the authority granted to the first projector were granted to the second. The actual letters patent reissued to Drake have not been found; and the secrecy in which the great voyage was cloaked may continue to balk the most careful search for them. But the testimony of the victims in the dungeons at Lima precludes the idea that what was furnished to Grenville was afterwards denied to Drake.

But what was the document in the archives of Mexico that first attracted Mrs. Nuttall's attention and led the way to her other discoveries? It was an examination of Drake's Portuguese pilot, Nuño da Silva, as to all that he observed while in company with the English. Many questions were propounded to him, but none more eagerly by the Inquisitors than this, "Did the corsair carry a warrant from his Queen?"

In his reply Nuño da Silva answered "that Francis Drake and all his men said so, and that in Abra de Islas, where they wintered, when he beheaded the said English gentleman who was named Master Doughty, the said Master Doughty challenged him to show whence and by what power he could behead him, and that then the said Francis Drake assembled all his men without omitting a single one. Placing himself in a more elevated position than the others, he took out some papers, kissed them, raised them to his forehead, and read with a loud voice. After reading them he showed them to the others and all saw and inspected them. After the head had been severed he took it in his hand, showed it, and then cast it away, saying, 'Long live the Queen of England!' All present said that those papers were his, and from her, and that it was with her authority that he was executing [Doughty] and making this voyage."

Taken by itself, this piece of evidence is significantly impartial; taken in conjunction with what has already been adduced, it may almost be called conclusive.

There is further testimony, however, of a negative kind which Drake's detractors generally overlook. John Doughty, brother of Thomas (and melodramatic villain of Mr. Parker's pageant-play), also accompanied Drake round the world, was present at his brother's trial and execution, and returned with a whole skin. He was highly connected, had wealth at his command, and the best legal advice was his for the asking. Is it credible that Drake would have escaped the long arm of the law if there had been no letters patent to protect him?

When the Queen heard the story of the voyage in full, with her lords and ladies she proceeded to Deptford, where she went on board the *Golden Hind*. There, in the presence of the foreign ambassadors, she conferred on Drake the accolade. She may have had her faults. She sometimes found it difficult to make up her mind; she sometimes favoured the undeserving. She often treated her nobles like schoolboys; and swore at her Ministers with the relish of a fishwife. But she never forgot the pride of her race, nor what her throne required; and neither flattery, adulation, nor all the jewels of the Indies would have coaxed her to tarnish the sword in her hand by conferring knighthood on a murderer.

Is it, then, too much to ask the grand jury of his

countrymen to acquit Drake of a charge which should never have been brought forward, and to substitute for the vile caricatures of Bernardino de Mendoza the faithful little cameo from Fuller's *Worthies*: "A very religious man towards God; chaste in his life; just in his dealings; true of his word; and merciful to those that were under him"?

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Our Knowledge of the Moon

By Rev. Hector Macpherson, M.A., F.R.A.S., F.R.S.E.

THE moon is our nearest neighbour in space; in fact, it is our earth's peculiar possession—"a detached continent," to quote Flammarion's picturesque phrase. Yet its physical condition is to a certain extent shrouded in mystery; astronomers are not agreed among themselves as to whether or not changes are taking place on its barren surface. From time to time the pendulum of opinion has swung somewhat violently concerning the physical condition of our satellite. In the early days of telescopic astronomy, extravagant notions were entertained of a lunar world analogous to the terrestrial, with oceans, vegetation, and inhabitants. As time went on, it became evident that the moon was a very different world from the earth. In 1794 Herschel pointed out "that we perceive no large seas in the moon, that its atmosphere (the existence of which has even been doubted by many) is extremely rare and unfit for the purposes of animal life; that its climates, its seasons, and the length of its days totally differ from ours; that without dense clouds (which the moon has not) there can be no rain; perhaps no rivers, no lakes." Nevertheless, he clung to belief in the habitability of the moon, holding that its inhabitants "are fitted to their conditions as well as we on this globe are to ours."

Up to the close of the eighteenth century observations of the moon had been sporadic, and work done had been unsystematic. Consequently, beyond the mapping and naming of the larger surface-features, little progress had been made. The foundation of lunar astronomy—or selenography—as a distinct branch of the science was due to Schröter, of Lilienthal, the contemporary of Herschel, whose long-sustained study marked the commencement of the comparative investigation of the lunar surface. Schröter laboured under the handicap of bad draughtsmanship; and he lacked that faculty of subordinating theory to observation which was so characteristic a feature of his great contemporary. To him the moon was a living world, with volcanoes in active eruption and an appreciable atmosphere. Mädler considered that this preconceived idea impaired the value of his work, inasmuch as he was too desirous of recognising signs of change on the moon. Nevertheless, his observations mark the beginning of that detailed study of the lunar surface which is the necessary preliminary to any tenable theory of the condition of our satellite.

Schröter was followed by Lohrmann, a land-surveyor of Dresden, who turned his attention from the survey of the terrestrial to that of the lunar surface. Lohrmann had published four out of twenty-five sections of a detailed lunar chart, when failing sight compelled him to abandon the project. About the same time, Mädler, then a struggling tutor in Berlin—in co-operation with his wealthy pupil, Beer—commenced his well-known survey of the moon's surface, with the aid of a four-inch refracting telescope. The result of this survey was the famous chart—issued in four parts, 1834–1836—which was succeeded in 1837 by a descriptive volume entitled *Der Mond*, in which the authors recapitulated the sum of human knowledge concerning our satellite.

Beer and Mädler's view of the lunar world—changeless, airless, and lifeless—was much nearer the truth than the "baseless fabrics" of Schröter's visions. At the same time, the publication of the book tended to discourage further investigation. Beer and Mädler were believed to have ascertained all that was worth knowing, and to have established the fact that the moon was destitute of change of any kind.

One or two observers, however, were undismayed by the generally accepted view that the moon was a dead world. Of these the chief was Schmidt, the German director of the Greek National Observatory. Schmidt studied the moon for a much longer period than Mädler; indeed, his great chart, published in 1878, was the outcome of forty years of untiring labour. In 1866 he brought forward strong evidence of change on the moon's surface, in the almost complete effacement of the small crater, Linné. Lohrmann and

Mädler had observed and delineated the crater under a totally different aspect, as had also Schmidt himself. This observation, confirmed by other astronomers, was followed by the equally startling announcement by Klein, of Cologne, in 1879, of the formation of a new crater.

Nevertheless, the majority of astronomers adhered to Mädler's view. Nasmyth and Carpenter, in their classical work on *The Moon*, expressed "the strong belief that no vestige of its former volcanic activity lingers on the moon—that it assumed its final condition an inconceivable number of ages ago"; while conceding that "minute changes of a non-volcanic character may be proceeding in the moon, arising from the violent alternations of temperature to which the surface is exposed during the lunar day and night." Flammarion, forty years ago, was as a voice crying in the wilderness. Referring to the darkening of the floor of the great walled-plain Plato with the progress of the lunar day, he expressed the view that "the odds are ninety-nine to one that it is not the light which produces the effect, and that it is the solar heat. . . . It is highly probable that this periodical change of tint on the circular plain of Plato, visible every month to any attentive observer, is due to a modification of a vegetable nature, produced by the temperature."

The work of Schmidt was carried forward by a number of painstaking English amateurs, chief among whom was the late Mr. T. G. Elger, of Bedford. In 1895 Elger published his reasoned conclusions in a balanced and cautious way in his volume on *The Moon*. His standpoint represented a reaction from the view of Mädler and from the much more extreme version of that view given in so many textbooks. "The knowledge we possess," he wrote, "even of the larger and more prominent objects, is far too slight to justify us in maintaining that changes which on earth we should use a strong adjective to describe have not taken place in connection with some of them in recent years." Elger himself inclined to belief in change. Referring to the varying tints of some of the level regions, he cautiously remarked: "It has been attempted to account for these phenomena by supposing the existence of some kind of vegetation, but as this involves the presence of an atmosphere, the idea hardly finds favour at the present time, though perhaps the possibility of plant growth in the low-lying districts, where a gaseous medium may prevail, is not altogether so chimerical a notion as to be unworthy of consideration." He stated, however, his strong conviction of the need of further intensive study, maintaining that only by confining attention to selected areas of limited extent, and by studying every visible object under all conditions of illumination, could progress be made. "A complete photographic survey of a few selected regions as a basis for an equally thorough and exhaustive scrutiny by direct observation would, it is believed, lead to a much more satisfactory and hopeful method for intimately furnishing irrefragable testimony as to permanency or change than any that has been undertaken."

Elger died in 1897; three years later his suggestion was put into practice by Professor W. H. Pickering, of Harvard, who since the beginning of the century has had the field of lunar astronomy practically to himself. On August 12, 1892, an occultation of Jupiter was observed by Pickering at Arequipa, in Peru, and the slight flattening of the disc was attributed by him to refraction in a lunar atmosphere of extreme tenuity. His observations of the crater Linné during the next few years confirmed him in the belief that the moon was by no means destitute of change. In 1899 an expedition to Jamaica convinced him of the excellence of its climate for the photographic and visual study of the moon, and in 1900 the Harvard astronomical station was erected at Mandeville, a convenient point in the island. The photographs of the lunar surface taken during the following year formed the basis of the large atlas, containing many plates and descriptive matter, which was published towards the close of 1903 under the title of *The Moon*.

Pickering was not the first to apply photography to the lunar surface. At the Lick Observatory a large altas was commenced, but the project was discontinued. At the Paris Observatory Loewy and Puiseux obtained many beautiful photographs; while Weinek, of Prague, formed an atlas combining many Paris and Lick photographs. But the amassing of large numbers of isolated photographs is in itself insufficient to settle the vexed question of change, or, indeed, to add much to our knowledge of the moon. Pickering was the first investigator to carry out the idea of Elger—photography of a few selected regions as a basis for an exhaustive scrutiny by direct observation. The idea has been justified by the progress of selenography since the beginning of the century. Indeed, there has been developed what Pickering himself calls the "new selenography"—"the selenography which consists not in a mere mapping of cold dead rocks and isolated craters, but in a study of the daily alterations that take place on small selected regions—changes that cannot be explained by shifting shadows or varying librations of the lunar surface."

A close study of these "small selected regions" convinced Pickering as early as 1902 that the conventional view of the moon as an absolutely dead world was untenable. He had concluded ten years earlier that a very thin atmosphere does exist, with a density probably not exceeding one ten-thousandth part

of our own; and his later work indicated that his conclusion had been correct. It is obvious that only the heavier gases can be components of such an atmosphere; the lighter gases must have long since escaped into space. Indeed, Pickering declares that "any gas that was not constantly renewed from the moon's interior would have practically disappeared from its surface long ago. Let us now see what gases are at the present time being given off from the earth's interior. We find that there are only two that escape in large quantities—carbonic acid and water-vapour. The former would remain for some time on the moon's surface on account of its weight, and the latter because, on account of the low pressure, the rapid evaporation would cause it immediately to freeze."

These theoretical considerations form the background of Pickering's theory of the lunar surface, where he believes volcanic activity to persist on a small scale, and hoar-frost to be extensively deposited. Those who accepted the evidence of Schmidt, Klein, and others as to changes on the moon usually attributed them to the crumbling of rocks due to the extreme range of temperature. Few believed in the existence even of feebly active volcanoes. Accordingly, when Pickering first saw the small crater at the source of a deep winding cleft known as "Schröter's Valley," he was amazed by its strong resemblance to the crater of a terrestrial volcano in active eruption. Clouds of white vapour, of great density, were seen rising from the bottom of the crater and pouring over its south-eastern wall. Observations at Cambridge, Mass., and at Mandeville, confirmed these early results, and showed that this activity commenced a day or two after lunar sunrise, increased to a maximum, and ceased a few days before sunset. Even the few examples which Pickering cited in 1903 were sufficiently striking to lend strong support to the view that lunar volcanic activity had not altogether ceased.

As water-vapour cannot liquefy on the moon's surface, owing to the low pressure, it must immediately freeze. If so, therefore, one would naturally expect to find evidences of snow or hoar-frost on the lunar surface. This is exactly what Pickering has found. He has ascertained that a considerable number of craterlets are lined with a white substance, which becomes more and more brilliant as the sun shines upon it. The same substance is to be seen on certain mountain peaks. Many of these features have been detected, because Pickering has not confined his studies of lunar formations, as most selenographers have done, to the periods of lunar sunrise and sunset when they are most clearly defined. He holds, indeed, that "the only time when the moon is interesting to one who is really used to its surface is when changes are taking place on it, and these only occur far from the terminator; that is, during the lunar summer-time."

Round the small crater Linné is a halo of bright material, which becomes visible a day or two after sunrise. Pickering made a series of measurements of this halo, but they were strangely discordant. At first, indeed, the results seemed inexplicable until it occurred to him "to compare the diameters of the area in question with the number of hours that it had been exposed in each case to the sun. The whole matter then became clear. When the white spot first became visible, one and a half days after lunar sunrise, it was five miles in diameter. As the sun rose the spot rapidly diminished in size, until one day after the lunar noon it was only two and a half miles in diameter. From then till one and a half days before sunset, when it disappeared, it steadily increased in size, reaching a diameter of four miles. During the lunar night it must have continued to increase, until after sunrise it became, as before, five miles in diameter."

The visibility of snow or hoar-frost on the moon is conditioned by two opposing factors: (1) The snow tends to melt under the direct rays of the sun; and (2) the snow only becomes visible when illuminated by the sunlight. As the sun rises higher in the sky, it shines into crevices on the surface and illuminates white regions previously invisible. A striking instance of increasing visibility is that of the bright streaks or "rays" surrounding certain prominent craters, more particularly the conspicuous formation known as Tycho. These streaks, which are seen only about the period of full moon, were a standing puzzle to the older selenographers. Nasmyth supposed them to be due to cracks in the surface filled by an outflow of white material from the interior of the moon, and in this he was followed by Proctor. Pickering's explanation is much simpler. The snow which gives rise to these "rays" lies in crevices, and cannot become visible until the sun has attained a certain altitude. Less convincing, perhaps, is Pickering's explanation of why snow is deposited in these crevices—by winds blowing in certain directions. That the tenuous atmosphere must have some mode of circulation is manifest, however, from recent investigations in 1917 of the minute craterlets near the formation known as Theophilus. The water-vapour expelled from the crater cone obviously does not freeze as it ascends. There is some form of atmospheric diffusion. "These changing snow areas seem necessarily to involve the existence of low cloud or fog in some form or another, and thin clouds doubtless account for some of the less brilliant areas observed." Confirmatory evidence of the existence of fog was obtained four years ago by the Italian astronomer Maggini at Florence. On October 10, 1916, while observing Plato, he noted that

a minute craterlet on the floor became invisible, while a reddish mist extended over a portion of the floor and also over the rampart. After three-quarters of an hour the mist cleared away, and the craterlet again became visible.

The evidence which Pickering has collected of the existence of some form of vegetation on the lunar surface is pretty strong, if not fairly conclusive. The possibility of the presence of vegetation was mentioned as long ago as 1858 by De la Rue, while Flammarion suggested it as the explanation of the darkening of the floor of Plato. However, the majority of astronomers dismissed the idea as absurd. Unperturbed by the prevailing scepticism, Pickering began as early as 1893 to make close investigation of a number of variable spots, which darkened rapidly after sunrise and faded out towards sunset. A considerable number of these spots have been studied by him, and it is difficult to refute his contention that they represent a rudimentary kind of vegetation springing up and withering during the long lunar day, which is more analogous to our terrestrial year than to our day. Regarding the nature of this vegetation we know nothing. Pickering has pointed out, however, that "lunar vegetation would have two distinct advantages over our own. In the first place, since the force of gravity is less upon the moon, the same leaves or fronds or branches would require but one-sixth the effort to lift and support themselves that would be necessary were they transplanted to our earth. Secondly, since there are no high winds upon the moon, if it were any advantage to plant life to lift itself above the surface of the ground, it could do so with safety, instead of clinging close to the rocks, like our own arctic and antarctic flora."

It must be admitted that many astronomers hesitate to accept Pickering's conclusions. In a recent lecture, Professor Aitken, of the Lick Observatory, remarked that "further confirmatory observations are desirable before we accept these changes so demonstrated; and even then we may well hesitate to accept the explanations that have been offered." But we must bear in mind that the critics of Pickering's views have devoted no special attention to the surface of the moon, while Pickering is the one prominent observer who, under favourable atmospheric conditions, has studied the moon intensively for over a quarter of a century. Naturally, therefore, Professor Pickering's conclusions must be admitted to carry a great deal more weight than the objections of his critics, however eminent these may be in other branches of astronomy. Therefore we may say, with some degree of confidence, that the balance of evidence is on the side of the view that changes do take place on the moon; in other words, that the moon is not a dead, but a dying, world.

The Herd Instinct taken Seriously

By T. H. Pear, M.A., B.Sc.

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In 1908 and 1909 there appeared in the *Sociological Review* two essays on the Herd Instinct by Mr. W. Trotter. It is fair to say that, whether the reason lay in the unfashionableness of this journal, or the mental resistiveness of the public in 1908, they produced little visible impression upon any but a small circle of workers. Then came the war, and during it, the middle part—"Speculations upon the Human Mind in 1915"—of the present book.[1] This essay contained a comparison of German with English mentality. To many such an effort seemed foredoomed to failure, "for who," they would ask, "can write an unprejudiced account of his own nation or that of his enemy at such a time?" This question, however, is just the one which Mr. Trotter put to himself, and the manner of his answer; the calm, patient, yet firm way in which he has handled some ugly facts commands our profound respect.

Pointing out that one of the best acid-tests to which any scientific hypothesis may be put is its power to foretell the future, he recorded certain reasoned-out prophecies, knowing that before long events would be forthcoming to confirm or refute them. The reader will be interested in, and perhaps surprised at, the opinion, written in 1915, that even though Germany might represent the conflict to others and to herself as a war of defence, there would not be much fighting on German soil.

The postscript of 1919, which is the new feature of the second edition, is not only a perfect example of the art of consolidating one's gains without at any moment appearing to say, "I told you so"; it is perhaps the most sympathetic description and analysis of the post-war weariness, the reasserted segregation of classes (the directions of whose lines of demarcation have probably changed rather less than certain buoyant writers would have us believe), and the sudden deep drop "from the high constancy of spirit by which, throughout the long pilgrimage of war, so many weary feet have been upborne, so many dry lips refreshed."

It will be interesting to watch for criticisms of this postscript by our professional writers upon political affairs. In the light of Mr. Trotter's account of the mind of the politician one might venture a prophecy: but the reader may be left to formulate his own after he has finished the book.

[1] *Instincts of the Herd in Peace and War*, by W. Trotter. Second edition, enlarged. (London, Fisher Unwin. 8*s.* 6*d.*)

It is impossible to deal adequately here with the substance of the two latter parts of this book, for, as the Irishman said of his three hours' address when asked to summarise it, "it's all gist." The first two essays, however—"Herd Instinct and its Bearing on the Psychology of Civilised Man," and "Sociological Applications of the Psychology of Herd Instinct"—interest the psychologist (or, rather, ought to interest him, for even psychologists have their insensitive sides) because they have already existed in print, and have therefore been open to criticism for ten years.

It may seem strange to say that those essays were simply a plea that the gregarious instinct in man should be taken seriously. They certainly appeared a little while before Nietzsche became the personal property of our Sunday newspapers, though by this time the "psychology" of crowds was a firmly established journalistic favourite. Books which claimed to deal with sociology were already numerous—why, then, this plea?

Mr. Trotter's opinion, if we gather it rightly from his book, is that when the average observer of human behaviour attempts to describe man's undoubted tendency to live in herds of rapidly increasing size, he does little more than to state the obvious facts and to give examples of them. Now this bodily gregariousness, as we may call man's tendency to huddle into the physical proximity of his fellows, which leads to that blackening of the earth's surface with human figures on the downs of Epsom or the front at Blackpool, is by no means the most important feature of the gregarious tendencies which he displays. This merely physical gregariousness is usually described in the detached way which we might expect from an aeroplane observer, or from a philosophical writer peering down from the even remoter altitudes to which he usually soars and at which, not infrequently, he remains.

But this absentee-account of the behaviour of one's fellow-creatures, however kindly and tolerant it may be—though often it is nothing of the kind—is psychologically a thin and poor thing. We would cheerfully exchange most of it for half a dozen of O. Henry's stories of the Four Million, or for an account of life in North London as seen by Mr. Pett Ridge. And for this reason: these two writers make us realise something which the observers in the more rarefied atmosphere do not—the deeply pathetic, profoundly ridiculous, savagely cruel, and infinitely noble *mental* expressions of gregariousness. For all these things arise not as accidents attributable to mere physical proximity, but as definite biological results. Gregariousness, Mr. Trotter believes, "must have consequences as precise, and a significance as ascertainable, as the secretion of the gastric juice or the refracting apparatus of the eye."

To put this in another way: hitherto the cultured writer, knowing that he is relatively immune to the simple mind's fear of bodily solitude, has implicitly or explicitly congratulated himself on possessing few of the more primitive characteristics of gregariousness. But it often seems to be only another product of this same gregarious instinct which insures our friend against such a fear. His bodily isolation is off-set by the fact that in thought he can choose his own company: that, perhaps, he never feels so sociable as when he is alone. Yet to such a first-class traveller on life's journey, the fear of mental loneliness may some day come with perfectly hideous intensity. The possibility of being ostracised by his "set"; excommunicated by his Church; misunderstood by his nearest and dearest—these may straddle across his path so menacingly that any thought or desire which would conflict with the teachings of his herd is switched off automatically while its faintest incipient glimmerings are still at the back of his mind. Before this striking exhibition of man's gregariousness, the Derby Day crowd, "like flies on a plate," as Herbert Spencer described it, becomes so simple as to be almost uninteresting. The mental serenity and complacency of the most superior of superior persons may have been derived from his herd in a way only slightly more complex than that which brings about the visible beatitude, described by Galton, of the South African ox, romping into the company of his fellows after the briefest separation from them.

It is just here that Mr. Trotter offers to psychology either a new discovery or a challenge. If the former, it is scarcely possible to overrate the significance of his book, not only for psychology, but for history, political science, ethics; in fact for every study which honestly attempts to understand the complexities of social behaviour. On the other hand, if Mr. Trotter's suggestion be a challenge, it is remarkable that his gage has remained on the ground so long. We may proceed more easily upon the path which he has indicated if we take some compass-bearings at its beginning. He begins from two truths in biology and psychology respectively. The first is that gregariousness in animals increases enormously their capabilities of offence and defence, and that any member of the herd, in return for the protection from natural selection which his commune affords him, pays the price of a loss of individuality of behaviour. But he goes farther, and points out that, in human beings, this stereotyping of behaviour is paralleled by a similar process in the realm of thought; that man's political and religious beliefs illustrate the advantages and disadvantages of standardised mass-production even more brilliantly than the most popular motor-car.

The second fact from which he sets out is a psycho-

logical one, analysed and established, as he says, with a "quite final delicacy and precision," by Professor William James. James "showed that the impulse of an instinct reveals itself as an axiomatically obvious proposition, as something which is so clearly 'sense' that any idea of discussing its basis is foolish or wicked."

So far Mr. Trotter has not departed in any way from the average psychologist's point of view. But his new path begins here, in that he believes that the herd instinct is not only itself the cause of axiomatically obvious impulses, but may lend to any ideal, impulse, habit, or belief, however recently acquired, this character of immediate obviousness. Such beliefs may be held regarding complex subjects like Home Rule or Guild Socialism, or such apparently simple ones as the propriety of wearing made-up neckties or the correct method of eating asparagus. In these cases the feeling of rightness or wrongness is usually "axiomatically obvious," the phrase "It's not done" and the epithet "outsider" providing further evidence in support of Mr. Trotter's theory.

We are therefore asked to believe that the herd instinct can suffuse, or, if we may use, not too rigidly, an analogy, electrify or magnetise an impulse which itself is clearly not instinctive, and may be a very recent acquirement, having no existential value. This is not the place to discuss the effect which the acceptance of such a belief would have on psychology in general; but there is no doubt that some such explanation is required to explain an obvious but important fact. Most people, ninety-nine times out of a hundred, do or think things which their community calls moral or right, not because of any anticipation of reward or punishment, material or social, of praise or blame, of approval or disapproval, but just because it never enters their heads to behave otherwise. Their reasons for doing the "right" thing, though frequently interesting, are usually rationalisations after the event. This, if the present reviewer has grasped Mr. Trotter correctly, is one of the essential facts upon which the strength of his theory depends.

We have no intention of quarrelling here with Mr. Trotter's selection of the words "herd" and "instinct." It is perhaps unfortunate that most of us usually apply the term "herd" to the community (or the plate, to adopt the Spencerian simile) to which someone else belongs, but there is no cogent reason why in future we should not deny ourselves the pleasure of limiting this word's functions to those of a missile. Concerning the word "instinct," however, much more might be said in a technical article, and it seems likely that Mr. Trotter has been misunderstood because he has used a very ordinary word to stand for an extraordinarily complex set of phenomena. To the present writer it appears that the difference, for example, between Professor McDougall's use of the term "gregarious instinct" and Mr. Trotter's use of "herd instinct" is not unlike the difference between the chemist's and the temperance advocate's respective uses of the word "alcohol." The latter does not mean seriously that the average man is prone to feel an overwhelming temptation to drink a liquid the chemical constitution of which can be simply written as C_2H_6O; what he does mean is that the more companionable liquids against which his energies are directed contain alcohol as their indispensable, but not necessarily as their most characteristic, constituent. It may be that upon analysis Mr. Trotter's "herd instinct" will prove to contain a relatively large number of complex products, like the ingredients which make up the flavour of an old wine. We may surmise that such an analysis would result in the discovery of instincts other than the gregarious instinct, habits, and—to use Mr. A. F. Shand's admirable conception—sentiments and integrations of sentiments. Be that as it may, there is very little doubt that Mr. Trotter, once and for all, has set an example, which most other psychologists would do well to copy, of treating, with the seriousness which they deserve, man's gregarious tendencies, their illimitable possibilities and some of their ghastly actualities.

Until quite recently a serious defect in the majority of writings upon social psychology was their neglect of one of the most important phenomena of civilised mentality: mental or moral conflict. The character of the ordinary imperfect human being is seldom built up by an uninterrupted sequence of orderly superpositions of moral acquirements. More often, especially if the person in question be the possessor of an alert, sensitive, and imaginative mind, this structure bears only too plainly, even in its outward pattern, the marks of conflict, not only with others, but with himself. The recognition of this fact in twentieth-century psychology is largely, perhaps almost entirely, due to those pioneers of psychological medicine Janet and Freud. Mr. Trotter was inoculated with these views at a comparatively early date, and the way in which they have influenced him may be a little startling to any reader who has derived his conceptions of Freud's teachings from casual conversation, from the writings of our younger novelists, or from a recent delightful poem in *Punch*. We might go so far as to say that the very nature and functions of Mr. Punch himself would form a most entrancing problem to a student of society who has fully grasped Mr. Trotter's conception of the strengthening influence exerted by mental gregariousness. He might, for example, begin with an analytical comparison of the political cartoons published before and since the Armistice.

Mr. Trotter, then, in a sense, belongs to those writers who—to borrow the poem's jolly rhythm—" derive their inspiration from the works of Jung and Freud," but the colour of the illumination which he focuses upon the present state of society from these writings is quite refreshingly new. Even his attitude towards the psycho-analysts themselves is original. At times one almost gets the impression that he is shocked by the respectability and conventionality of the Vienna school of thought. We hasten to say that it is as a biologist that he is so distressed. He points out a lacuna in the Freudian social psychology which seems so glaring—after one has read Mr. Trotter—that one is left wondering how it could have been allowed to gape so long. Accepting the psycho-analysts' account of mental conflict and repression, he emphasises that, while vividly describing and attempting to explain the process of repression, they often appear compliantly to have taken for granted the permanence—perhaps even the rightness—of the social barriers which bring it about. And some of those barriers are the jealousy of the older towards the younger generation, the apathy and comfort of the well-fed, the serenity and calm which are often merely another aspect of unimaginative stolidity, the righteous satisfaction which is sometimes difficult to distinguish from Pecksniffery or Junkerism.

So far the psycho-analytic school has cast little direct light upon an important question: How many of these imposing hurdles in life's obstacle-race could be desirably lopped down or even removed? Mr. Trotter reminds us of the cynical complacency with which the middle-aged write of the " storm and stress " of adolescence, as if these are due merely to internal —and therefore, doubtless, beneficial—growing pains, and in no way caused by friction against shackles which need never have been forged. A year or so ago a reviewer put the same thing in another way when he described a book as suggesting to parents a number of ingenious solutions of children's religious difficulties which ought never to have occurred.

Mr. Trotter himself says, " However much one may be impressed by the greatness of the edifice which Freud has built up, and by the soundness of his architecture, one can scarcely fail, on coming into it from the bracing atmosphere of the biological sciences, to be oppressed by the odour of humanity by which it is pervaded. One finds everywhere a tendency to the acceptance of human standards, and even sometimes of human pretensions, which cannot fail to produce a certain uneasiness as to the validity, if not of his doctrines, at any rate of the forms in which they are expounded."

Another conception of this writer which immediately attracts the psychologist's attention is his suggested division of minds into sensitive, and resistive or " normal." His two pictures, singularly incisive, though perhaps outlined with too hard a pencil, describe types known to all of us: the person unusually pervious to the lessons of his own personal experience, even when it contradicts the teaching of his leaders and his elders, and the one with his ears constantly pricked towards the herd, immediately rejecting or questioning the validity of his own personal experience when it conflicts with the beliefs and traditions of his community. Such a mind's " resilience to the depressing influence of facts " has attracted many thinkers before Mr. Trotter, but probably none before him have used Freud's teaching in an attempt to discover the biological process by which such a mind's protective armour grows. As Mr. Trotter's thesis is not only that these resistive minds tend by their very stability to become the backbone of the State, but that the post-war condition of our own country, and that of many others, is largely attributable to their dominance by this type, his book will interest many to whom psychology is little more than a name.

This review has attempted to discuss one only of the many brilliant aspects of this book. The eloquent postscript of 1919 speaks for itself and needs no exposition by others.

Mr. Trotter is a surgeon. Here we see him cutting deep into the tissues of the body politic, wisely declining to administer an anæsthetic, and laying bare society's malformations and pathological adhesions. The professional surgeons of the mind may—they almost certainly will—criticise the manner of his dissection. But, at any rate, they should find it rather difficult to regard him as an unqualified practitioner.

Wireless in Aircraft

By J. Brown, M.B.E., M.C., M.A., B.Sc.

It is not proposed here to deal with any of the technical difficulties associated with wireless signalling from aircraft, nor to give descriptions of the special apparatus required for this purpose, as the understanding of these requires a certain amount of specialised and technical knowledge. It will suffice to outline some of the recent developments which have taken place in aircraft wireless, and show to what use these have been, and are being, put.

Wireless telegraphy, though quite a young branch of electrical science, was well known as a successful means of communication before the recent war: many land and ship stations existed, the value of wireless

in naval and military operations and in commerce was fully recognised, and suitable types of apparatus were available for such purposes. With aircraft, however, this was not the case. At the outbreak of war the use of wireless in connection with aircraft had not got beyond the initial experimental stage, and no standard types of apparatus had been adopted. The need for rapid and efficient communication between aircraft and the ground was urgent, and under the stress of war conditions suitable types of apparatus were devised and manufactured. During the years of war these changed very considerably as one improvement followed another, new developments took place, and new conditions and increased functions demanded new types. The development has been one of triumphal progress ; enormous difficulties have been overcome, with the result that to-day there is little or nothing in connection with wireless on land or sea which cannot also be done in the air.

A wireless station, whether on land, on sea, or in the air, requires (*a*) electrical power, (*b*) transmitting and receiving apparatus, (*c*) an aerial, and (*d*) an "earth." It is easy to make provision for all of these on land or on ship, where sources of electrical power are available, where an aerial can be erected on masts, where an "earth" is obtained by contact with the ground or with the sea, and where there is practically no limit to the weight or bulk of the necessary apparatus. In the air, however, conditions are different ; as the space available in aircraft is very limited, and weights have to be reduced to a minimum, no large or heavy power plant or apparatus can be carried. The workmanship achieved in this direction during the war was very fine ; transmitters of considerable range for use chiefly in aeroplanes weighed only from 5 to 10 lb., while electric generators capable of producing 600 volts weighed about 18 lb. The source of power for transmitters varied with the type : in earlier and low-power sets accumulators were used, while later sets usually obtained their power from small wind-driven generators. These were fitted to the aircraft in a position in which they would experience the full rush of air while flying ; this turned the windmill propellor attached to the generator, and gave speeds of from 3,000 to 4,000 revolutions per minute. An alternative method to this was to drive the generator by gearing or belt direct from the main aircraft engine. This latter method was largely used in German aeroplanes, but was not adopted to any large extent in British machines, as the wind-driven generator has many advantages over the other. In aircraft the aerial consists of a long length of wire (from about 100 to 300 feet according to the wave-length to be used) with a lead weight at one end. During flight this is trailed from the machine and forms an efficient aerial. Before landing the wire it wound up on a reel. An aerial of this type is obviously an encumbrance to a fighting machine, and was, in some cases, replaced by a fixed aerial attached permanently to the framework of the aeroplane. The "earth" system is obtained by using the capacity of the engine, bracing wires, and other metal parts in the aircraft.

One of the main duties of aircraft during war, and one in which wireless plays an important part, is that of observation of artillery fire, or what is commonly called "spotting." In this co-operation between aircraft and artillery wireless is indispensable. In the early days of the war co-operation was attempted by indicating targets by dropping smoke balls or firing coloured signals over them. This method was slow and unsatisfactory, as signals could not be seen very far, and the correction of the ranging by a very limited number of signals was not satisfactory. When wireless apparatus became available, great advances were made, and the success of aerial observation was assured. Large numbers of squadrons of aeroplanes were distributed along the whole front to co-operate with artillery. Pilots and observers were trained in the methods of observing and correcting artillery fire, were taught a little wireless telegraphy and Morse Code to enable them to report targets and maintain communication with artillery units while correcting their fire. Machines for this purpose were mostly equipped with small spark transmitters with an average range of about ten miles. The power of these sets was intentionally kept low to enable as large a number of machines as possible to work on a small sector without interfering with, or being interfered by, similar machines working in neighbouring sectors. Each heavy or siege battery was equipped with a small field set capable of maintaining communication with the aircraft. When a target was observed, a battery was called up by wireless and given the position of the target by means of its co-ordinates on a map ruled in squares. In a few minutes fire was opened on the target, and corrections sent in simple code from the aeroplane to the battery. With practice, gunners and aerial observers soon became very skilled and quick in ranging by this method, and most successful artillery work was achieved. When necessary, more than one battery engaged the target, and trained observers were able to correct the fire of several batteries at the same time. Arrangements also existed whereby, on a certain signal being sent by the aeroplane, the concentrated fire of a large number of batteries could be obtained at once on a target of special importance, such as a body of enemy troops, a railway train, collection of transport, or similar "fleeting target." Wireless has proved its value for work of this nature, and will continue to be necessary

in warfare as the best means of communication between aircraft and artillery, for with modern long-range guns correct observation of the fall of rounds is only possible from an observer hovering over the target. In future, wireless telegraphy may be replaced by wireless telephony for this purpose; this would allow more intimate communication between the observer and the battery commander. Apart from this there would appear to be no very great advantage in using telephony instead of telegraphy for the purpose.

A second important use to which wireless in aircraft was largely put during the war was in connection with long-range reconnaissance flights and bombing expeditions. In carrying out duties of this nature, aircraft flew many miles beyond the enemy front line, and obtained "intelligence" in the course of a three or more hours' flight which it was often essential to report at once without waiting till the whole flight was completed. For example, movements of enemy troops behind the line, concentrations of transport or rolling stock, lighted enemy aerodromes seen during night-flights, good bombing targets, etc., were matters of strategic importance of which immediate knowledge was necessary if action was to be taken in time; this information was best sent during flight by wireless to certain land stations erected for the purpose at suitable headquarters. The supreme importance of rapid communication in reporting enemy movements and dispositions is more fully realised under moving-battle conditions during a large advance or retreat such as took place in the initial and final stages of the war in France, and also in the final phases of the campaign in Palestine. Aircraft engaged on long-range reconnaissance and bombing duties were first equipped with long-range spark transmitters capable of maintaining efficient communication up to about 50 to 100 miles, or more if necessary. Later, after the development of the Three Electrode Oscillation-Valve,[1] and its adaptation for use in aircraft sets, these spark transmitters were replaced by continuous-wave transmitters giving much longer ranges for less power. These continuous-wave transmitters have many advantages over the older spark types, and are eminently suited in all respects for use in aircraft.

The next development to take place in aircraft wireless was in the use of wireless telephony. To the non-technical reader one may say that wireless telegraphy differs from wireless telephony just as ordinary telegraphy differs from ordinary telephony—in the one a code of dots and dashes is used to transmit the message, while in the other the message is transmitted as in ordinary spoken conversation. Wireless telephony demonstrations had been given between land stations before the war, but wireless speech had never been received in an aeroplane. The whole of this momentous development in aircraft wireless telephony has taken place during the years of war, and has been the result of long and patient industrious research and experiment on the part of a few able pioneers. The difficulties to be surmounted were tremendous. Telephone conversation on the ground is often not all that one could desire, but when this has to be undertaken in an aeroplane rushing through the air at about a hundred miles an hour, and amid the continuous roar of a high-power aeroplane engine so deafening that an observer can only hear his pilot's shouted words when the latter's mouth is close to his ear, one can, to a small extent, appreciate some of the difficulties to be overcome. By the perfection of a transmitter-microphone insensible to loud noises such as those of the engine, yet responsive to the modulations of the human voice, and by the use of high-magnification valve arrangements, satisfactory results were at length obtained, and a standard type of instrument was designed and manufactured which necessitated practically no adjustments in the air. With such sets, pilots and observers no longer required to learn the Morse Code and wireless signal procedure; this alone was a great benefit, and, moreover, considerable time was saved in the transmission of messages. Not only were aircraft able to maintain speech communication between themselves and the ground, but they were able to hold conversation with other aircraft in flight. This was of great value in "formation flying," when a number of aeroplanes fly in a body under the leadership of a commander who, by this means, can give directions and orders to the members of his formation and also maintain communication with the ground. For fighting purposes in the air this has obvious advantages; its value, too, was proved by its use in the squadrons employed in the defence of London, as machines on patrol duty in the air could be easily kept informed of the approach or movement of enemy aeroplanes or airships.

Before dealing with the latest development—namely, aircraft direction-finding wireless—it will be advisable to consider briefly and in the simplest possible terms the main principle involved in directional wireless as applied to aircraft.

If, while an operator at receiving station A (Fig. 1) listens to wireless signals sent with uniform power from a fixed station B, the receiving aerial AC be rotated about A, the strength of the received signals will be found to vary in intensity: the signals heard will be loudest when the receiving aerial lies in the straight line joining AB, as shown in the diagram. Now, orienting the aerial of a wireless station is no small

[1] This is described fully in recent textbooks on wireless, and also simply in the article on wireless by Lieut.-Col. Crawley in the July issue of DISCOVERY.

task, and is, in most cases, practically impossible. It is found, however, that signals can be received on a closed loop of wire, and that this can be used in certain

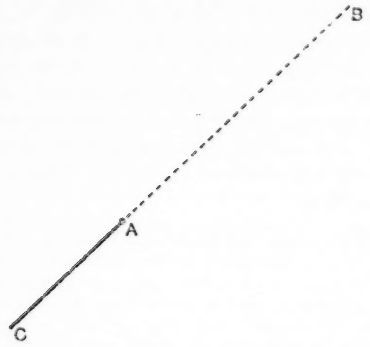

FIG. 1.

cases instead of an ordinary type of aerial. The loop consists of several turns of wire wound usually around the periphery of a large rectangular wooden frame. This is mounted so that it can be rotated conveniently about a vertical axis of symmetry in the plane of the coil.

Expressed mathematically, the energy absorbed by the coil PQ (Fig. 2) at receiving station R from the transmitting station T is proportional to cos θ, where θ is the angle which the coil makes with the straight line joining the transmitting and receiving stations. This energy will be a maximum when $\theta=0$, i.e. when the plane of the coil lies in the straight line joining the stations. In other words, signals received at R on coil PQ from station T will be loudest when PQ coincides with RT. The application of this principle to direction-finding is easy to see, for suppose the position of T is unknown. An observer at R listening to signals from T rotates the coil PQ until he finds the position in which the signals are loudest. He then knows that the coil PQ points to the unknown station. This is not sufficient to determine the posi-

FIG. 2.

tion of T, but if similar observations are made at a second station not in the same straight line as TR, the data are then sufficient to determine the exact position of T. Thus the position of the unknown wireless station X (Fig. 3) can be determined from observations made at two fixed stations Y and Z (Fig. 3). When X transmits, Y and Z, by means of their direction-finding apparatus, read off the magnetic bearing to the unknown station as determined by the position of the rotating coil when signals from X are loudest. The point of intersection of these two bearings gives the position of X. Stations Y and Z are, of course, in communication with each other, either by wireless or by land-line. It may here be remarked incidentally that by such means the position of enemy submarines, ships, headquarters, etc., using wireless during the war were determined.

With certain modifications and adjustments, the above principle has been successfully applied to aircraft, and at least two main methods are in use. In the first of these the aircraft carries the direction-finding wireless apparatus. To find his position at any time, the aircraft operator selects two land stations whose positions he knows accurately. When these stations transmit, he takes a bearing to each of them by means of his direction-finding apparatus. These two readings (which only take a matter of some seconds) are sufficient to enable him to plot his position accurately on the map. A check can be obtained by taking the bearing to a third station. This method is of great

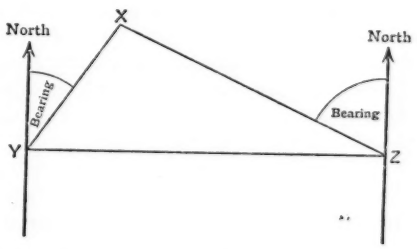

FIG. 3.

value, especially during war, as the aircraft can determine its position without transmitting and thus revealing its own presence. It also makes flying possible on cloudy nights when landmarks cannot be seen. The stations to which bearings are taken should obviously not be too close together. During peace-time, and also during war-time, there are always sufficient high-power wireless stations (such as Poldhu in Cornwall and Eiffel Tower in Paris) at work to enable these bearings to be taken. Also, for special flights, special transmission, if necessary, can be easily arranged.

For the second method no special direction-finding wireless apparatus is necessary in the aircraft. This is installed in the ground stations, and only an ordinary wireless installation is carried in the aircraft. When its position is required, the aircraft X (in Fig. 3) calls up stations Y and Z and asks for its position. Both Y and Z take bearings to the aircraft by means of

their direction-finding apparatus, Z transmits its bearing to Y, where, with the use of both bearings, the position is plotted and then communicated by wireless to the aircraft. The benefit to aircraft of this development in wireless is important, but full use has not yet been made of it. It affords a valuable help in aerial navigation—a science in which only a few aviators are sufficiently skilled. To steer an aeroplane or airship in the dark, or over a large expanse of water or desert where no guiding landmarks are available, or in clouds or fog, perhaps, too, in a wind whose speed and direction are only approximately known, is a task not to be undertaken by any ordinary aviator. Yet on long-distance flights such conditions may be encountered, and accordingly every possible source of help should be made available to the pilot, and not the least valuable of these sources is the use of wireless direction-finding apparatus.

Most of the foregoing developments have arisen from the demands of a war in which science has played a great part, and the high state of perfection attained in all types of aircraft wireless work in so short a time has been largely due to the pressure of war conditions. But such developments do not end with the war. Wireless is as essential to civilian aircraft in peace-time as it is to aircraft during war; it is as necessary for the safety of an aircraft and its passengers as it is for the safety of an ocean liner and her passengers. Since the Armistice considerable use has already been made of aircraft wireless; wireless telephony was used with success on the Folkestone-Cologne Aerial Postal Route, and on the London to Paris Air Route (still in use); wireless telegraphy and telephony have been largely and successfully used on several long demonstration flights by large aeroplanes, flying boats, and airships. The most important of these was the flight made in July 1919 by the airship "R34," from England to America and back. Her wireless equipment included a continuous-wave transmitter for long-range work, a low-power spark transmitter for communication with ships, direction-finding apparatus, a wireless telephone, and receiving apparatus with valve amplifier. The wireless results were highly satisfactory and some remarkable ranges were obtained. During the whole flight the airship was in wireless communication with stations on this side, or on the other side, of the Atlantic. Weather reports prepared by meteorologists in London were transmitted to her every few hours throughout the flight, and proved of great value. Signals were exchanged with the wireless station at St. John's, Newfoundland, over a distance of more than 1,700 miles. This was the first real test of long-range wireless communication with aircraft, and the results obtained surpassed all expectations. They have demonstrated what can be accomplished, and indicate what may be looked for in the future. If civil aviation is to become the success it deserves to be, one can look forward to the days when the world will be traversed by aerial routes over which aircraft (both heavier and lighter than air) will fly by day and by night, properly equipped with wireless telegraphy and telephony apparatus by means of which communication will be maintained with the ground, receiving weather reports, warnings and instructions when necessary, and guided by night and in cloud by a chain of wireless stations acting as "beacons" for direction-finding.

NOTE.—There are no textbooks on Wireless in Aircraft, but the reader who is interested in the subject may find some assistance in a series of articles, describing standard types of wireless apparatus used in aircraft during the war, which appeared in the *Wireless World* (a monthly magazine published by the Wireless Press, Ltd.), commencing April or May 1919. There are, however, many good textbooks on Wireless Telegraphy and Telephony. The simplest and most useful of these for the ordinary beginner is probably *The Elementary Principles of Wireless Telegraphy*, by R. D. Bangay (Wireless Press); in this book a section is devoted to oscillation valves and continuous-wave transmission and reception. Other suitable, though more advanced, textbooks are Rupert Stanley's *Wireless Telegraphy* (Longmans & Co.), Dowsett's *Wireless Telegraphy and Telephony* (Wireless Press), and Erskine-Murray's *Handbook of Wireless Telegraphy* ("The Electrician" Series).

Books of the Month

The following is our monthly selection of books which we commend to the notice of our readers.

FICTION

The Cross-Pull. By H. G. EVARTS. (Hodder & Stoughton, 8*s.* 6*d.*)

Bull-Dog Drummond. By CYRIL MCNEILE. (Hodder & Stoughton, 8*s.* 6*d.*)

Green Apple Harvest. By SHEILA KAYE-SMITH. (Cassell, 8*s.* 6*d.*)

A story of life in Sussex by one who is now in the first class of novelists.

Verena in the Midst. By E. V. LUCAS. (Methuen, 8*s.* 6*d.*)

They Went. By NORMAN DOUGLAS. (Chapman & Hall, 7*s.* 6*d.*)

GENERAL

On the Art of Reading. By SIR ARTHUR QUILLER-COUCH. (Cambridge University Press, 15*s.*)

Collected Poems. By EDWARD THOMAS. Foreword by WALTER DE LA MARE. (Selwyn & Blount, 10*s.* 6*d.*)

The Outline of History. Reader's Edition. By H. G. WELLS. (Cassell, 21*s.*)

This is an edition of Mr. Wells' remarkably fine history less sumptuous as regards illustration than that appearing in fortnightly parts, and consequently much cheaper.

New Studies of a Great Inheritance. By PROF. R. S. CONWAY. (John Murray, 12*s.* 6*d.*)

This book consists of lectures designed to represent some of the elements in the work of ancient writers which make their study of permanent value.

Letters of Mark Twain. (Chatto & Windus, 18*s.*)

This book contains also a biographical sketch and commentary on the letters, by Albert Bigelow Paine.

The Elements of Practical Psycho-Analysis. By DR. PAUL BOUSFIELD. (Kegan Paul, 10*s.* 6*d.*)

An account by a Harley Street man of the theory, technique, and scope of psycho-analysis in a form that may readily be understood by the student

The Advancement of Science, 1920. (John Murray, 6*s.*)

The addresses by the President of the British Association and of the Presidents of the twelve sections delivered at the Cardiff meeting in August.

Potatoes from Seeds

By Miss S. R. Graham

HAVE you ever speculated on the small shiny black balls sometimes seen on potato-haulms after the flowers have fallen? I often have, and wondered why the tiny seeds inside them could not reproduce their species like other seeds, and why potatoes must always be grown from tubers or "sets."

I was never able to obtain any satisfactory reason, and was always put off by the usual statements, "Oh! you can't grow potatoes like that. They only grow from 'sets'"; and when I persisted, and still asked why, no one seemed to know.

At last, however, my childish problem has been solved (in this country) by an enterprising firm of seedsmen, who, after having experimented with these seeds, has put them on the market, in the usual form, and offers prizes to growers obtaining the best results.

The outcome has been most interesting, for dozens of potatoes, of different shapes and sizes and colours, have resulted from the trials already made, and it is hoped that more far-reaching ends may yet be arrived at when more time has elasped in which to study the behaviour of the descendants of these potatoes bred on this new plan.

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Possibly a more hardy disease-resisting root than any yet known to us may evolve. More than that, the experiment may lead on to others, and some horticultural genius more talented than his fellows may hit upon an epoch-making discovery which may affect the food-supply of the whole world.

One such genius has already appeared.

I mean Luther Burbank, the plant wizard of California, whose services to his State and to mankind have been recognised in that neighbourhood by the setting apart of one day a year as a holiday in his honour, and calling it by his name.

I feel sure the English nation would do more than that for anyone who, following in his steps, could by some means increase, say, the yield of the sugar-cane tenfold! Who says this is an impossibility? I am confident that Burbank himself would not admit such a word.

A side-line to this study, less dramatic and striking perhaps, consists in converting what has formerly been an annual crop into a perennial one, with the attendant saving in tillage and seeding, although with naturally greater expenditure on manures. This has been already done in the case of perpetual spinach, and more lately still with broccoli; indeed, I have heard of these new broccoli yielding thirty heads in a season, and doing this continuously for several years; for they are hardy and resist any ordinary frosts.

Perhaps Burbank's greatest achievement of all, and the most valuable to man, is his spineless cactus.

This plant, as we all know, will flourish on waterless wastes where no other vegetation can exist. Also, it was previously known that the stems contained substances rendering them suitable fodder for cattle, but their prickly spines prevented them being of any use in this way, or in fact for anything. But Luther Burbank determined to overcome this difficulty, and trained all his intelligence on the task of creating a cactus without spines, in order that these erstwhile deserts should be no longer barren, but should become grazing lands for herds of beasts, which would find in the new production both food and drink —for the stems contain a large percentage of water.

The history of repeated experiments and disappointments before this end was attained need not be gone into; enough that thousands of acres formerly unprofitable now support large numbers of beasts, which in their turn become food for man; more still, this spineless cactus bears a wholesome and delicious fruit.

Among his other wonders are a white blackberry, a stoneless plum, a dwarf chestnut, and the potato called by his name. All those breed true, and go on doing so. The story of what he has accomplished on these lines on his twenty-two acres in California is a veritable romance. He is himself an enthusiast, as he must needs be, to persevere and keep on trying and trying again in the face of difficulties and set-backs. He has already achieved much, and has a whole-hearted faith in the immense future before this work, and the tremendous possibilities open to those who take it up. His thoughts were first directed to this study by those little potato seeds I mentioned. As a youth, he noticed a seed-cluster on a potato plant, and on sowing these the following year, he was amazed to find that each seed produced a potato absolutely distinct from its brethren. As a result of this experiment, he made sufficient money to take him from his home in Massachusetts to California, where he deemed the magnificent climate would be an important factor in the success of such work. There he has worked ever since, patiently and devotedly; some slight idea of *how* patiently may be formed when we consider that the Sun-berry took twenty-five years to produce a single berry. It was developed from two different *Solanums*, neither of which yielded an edible fruit.

His object in life is to make "two blades of grass grow where one grew before," in which he has been abundantly successful; although he holds that as yet we have only touched the fringe of this vast subject, and sees no reason why this earth could not easily support double the population it now does, if only more people would pursue this fascinating study in a truly scientific spirit.

And what pursuit could be more engrossing or far-reaching in its results? If a discoverer of new continents is a benefactor to mankind, is not he who enriches and beautifies the lands we already know, and enables them to produce two tons of grain, or whatever it may be, where only one grew before? Is not our homage and gratitude due to him in no less degree?

November Number

We hope to print the following articles in the next number:

1. *New Interpretations of Romanticism.* By Prof. J. G. Robertson.
2. *Nelson's Approach at Trafalgar.* By Prof. J. Holland Rose.
3. *The Independence of Psychology.* By Dr. C. S. Myers.
4. *The People of Ancient Rome.* By J. Whatmough.
5. *The Exploration of the Sea.* By Dr. R. N. Rudmose Brown.
6. *Pasteur.* By E. Cahen.
7. *The Potato.* By G. C. Gough.
8. *The Structure of an Atom.* By Dr. A. S. Russell.

The Discoveries in Crete

By George Glasgow, B.A.

(*Continued from August No., p.* 252)

VII

CRETE is the only land of the "prehistoric" Near East which has left no record of itself besides that revealed by excavation. And even the writing on the clay tablets cannot yet be read. We none the less get a vivid impression of Cretan life on its artistic side, and for this the main credit is due to the unique value of pottery in archæology. Pottery is almost indestructible. While it may decompose in soil that is damp enough, and the design may be obliterated when fire plays on it directly and when there is enough air for oxidisation, yet the actual fabric, being made originally of clay baked hard by extreme heat, can never be destroyed by fire. It cannot rust. It cannot be pounded into dust, because a small sherd has a tremendous power of resistance. While the stone ruins at Knossos will one day vanish from exposure to the weather, the pottery will remain. Even the defects of pottery are as valuable to the archæologist as its qualities. Its brittleness led to a constant deposit of breakages. The replacing of breakages in what was a household necessity led to continuous production. Its cheapness made it valueless to looters. When palaces were raided and burnt, metal objects were "lifted" either for their actual value or their potential value in the melting-pot. The pots remained. Thousands of sherds have been found on every site in Crete. Even when fragments cannot be pieced together, they reveal the kind of clay, decoration and thickness of the original vase, and complete examples are often found in tombs, where they were placed as offerings to the dead.

Pottery has been the chief instrument in the formulation of a system of dating. By assuming a lapse of a thousand years for every yard of deposit—except in the Stone Age, when the accumulation of débris was quicker because huts were built of ephemeral material such as mud and wickerwork—each successive layer is relatively dated according to its depth from the surface. Pots provide the nucleus for this scheme because they are found in large numbers in every layer. Other objects take their place according to the type of pots they are found with. The process is not simple. There are complicating factors, and even pottery creates difficulties and irregularities. At Knossos, for instance, when the first palace was built, the top of the hill was levelled and a portion of the former deposit thus cut away. Obviously, too, heirlooms would belong to an earlier time than that of

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the layer in which they are found. Or a pot may be displaced in the earth. A safeguard, however, against mistakes is afforded by the abundance of pots, which makes the differentiation of general classes easy.

Pots, then, are found at the lowest levels, just above virgin soil, for the earliest people used them and broke them. The slowness of development in that long-drawn-out period (the Neolithic or Later Stone Age) is clearly indicated. There are some seven yards of deposit belonging to it at Knossos, and the latest ware shows little or no improvement on the first. The pottery is hand-made, the clay coarse, generally of a sooty-greyish colour and more or less burnished. The relics consist of the rims and handles of pots, rims of basins, bowls, and plates and similar fragments, too incomplete to suggest original shapes. Two interesting points, however, can be seen. The pots were hand-polished both inside and out, and incised lines, or lines simply scratched on the surface, were used as ornamentation. This primitive manifestation of an artistic impulse was later extended by the filling of the incised lines with a white substance for greater effect. Similar ware has been found at Troy and in Egypt, and Dr. Mackenzie [1] has thought that these were an importation from the Ægean.

The irresistible impulse manifested even in primitive people to decorate their ordinary vessels is further illustrated by the fact that the polishing was gradually heightened, and the glitter thrown into relief by ripples, made with a blunt instrument, probably bone, and suggestive of the ripples on the surface of water. Among the latest Neolithic ware found at Knossos are two remarkable specimens of incised ware, the design being that of a twig with leaves. On each side of the stem is a row of small oblong punctuated points, filled in with white chalk. This, it must be remembered, in a period which ended about 3000 B.C.

The Bronze Age, which followed, and which brought with it the Minoan period at Knossos, is remarkable for the first use of paint. The transition was gradual and slow, and indeed, at the beginning of the Bronze Age, there is a falling off in the quality of the pottery. This was due to an interesting result of the discovery of metal, which turned the attention of skilled artists to the new medium, and left the fashioning of stone and clay to inferior hands. On the manufacturing side, however, it is probable that a great step forward was taken at that time. The fact that the clay is now of a terra-cotta or brick colour, as opposed to the former peaty grey of Neolithic times, has led to the surmise that the potter's kiln was now used for baking.

The first paint invented was an almost lustreless black, which was developed gradually into a lustrous black. Even this development was at first used as a mere imitation of the Neolithic black hand-polished vases. The paint was applied all over the vase, inside as well as outside, whenever the neck was wide enough. Neolithic incisions again were imitated by white geometric patterns painted over the black background. This style was not usual till the end of the Early Minoan period (E.M. III).

It was not till the beginning of the Middle Minoan period that any serious development took place. Then, however, it came in leaps and bounds. The potter's wheel had been introduced, probably from Egypt, at the end of E.M. I, and henceforth pots were "thrown" precisely as they are to-day. One can well imagine the keenness with which this great if simple invention was exploited. The fashioning of clay with thumb and fingers on a rotating wheel led so easily and inevitably to fineness of technique that the potter was soon imitating the thinness of metal, and by the end of M.M. II was producing "egg-shell" vases. In design the angular geometric patterns were displaced by the end of the Early Minoan period by curves and spirals, the logical outcome of the use of a brush. Colour meanwhile became lavish and brilliant. There were two styles: either the whole pot was first painted black to provide a background for a light design, or a dark design was painted on the original light-coloured clay. It was the first of these styles that naturally lent itself to colour display, and the name "polychrome" ("many-coloured") has been given to it. The other style (monochrome, or one-coloured) relied for its effect on a simple black-and-white contrast. In the latter case the light natural background was improved by a fine buff clay "slip" or wash. Quite naturally it was the polychrome style that mostly exercised the artists at first. Bright orange, lustreless white, yellow, red, crimson on a black background were exploited to a sometimes fantastic extent as long as the novelty of colour lasted.

The next development took place in the second Middle Minoan period (M.M. II). Relief was then introduced, which created an effect of light and shade on the black varnish. Mere blobs of colour, which constituted the original form of relief, soon developed into raised lumps and horns (the so-called "Barbotine" ware). Middle Minoan "Kamares," [2] or polychrome pottery, chiefly consisted of cups, "tea-cups," jugs, amphoræ (or two-handled jars), and fruit-stand vases.[3] In the M.M. II period large storage jars, or *pithoi*, made their first appearance. They were as big as a man, and almost exactly like the Cretan storage

[1] *Journal of Hellenic Studies*, vol. xxiii, p. 159.

[2] So called because the first specimens were found by Professor Myres in a cave on the slope of Mount Ida above the village of Kamares.

[3] The three best specimens are reproduced in colour in the *Journal of Hellenic Studies*, vol. xxiii, plate v.

jars of to-day. Two interesting features in the decoration of these jars are cunningly practical in origin. One was an imitation in relief of the coils of rope which were used in moving the jars, the other a "trickle" ornament produced by allowing splashes of paint to trickle down the side of the jar—a device which virtuously anticipated the inevitable trickles which would result from the storage of oil in it.

Towards the end of the Middle Minoan period the exaggerated use of colour which had marked the first introduction of polychrome ware gave way to a concentration upon design. Perhaps the most remarkable specimen of this later phase is the "lily vase" found at Knossos. It stands about two feet high, and for design has a simple row of lilies painted in white on a purple ground. The shape of the vase is artistically made to serve the design by enabling the lilies to bend slightly outward and then to curve in a little at the top.

Then came a curious clash in the separate evolution of polychrome and monochrome ware. The latter had been used as an easy decoration for ordinary vessels, but towards the end of the M.M. period the two styles began to coalesce in the form of a simple light design on a dark ground. Then a final resolution took place by a *volte face* into a monochrome dark on light brought about by the experience that the black varnish was a more durable colour than the lustreless colour pigments. The varnish, indeed, possessed a remarkable tenacity. It probably was the forerunner of that used in the later Attic Black Figure vases, whose secret is still exercising the ingenuity of modern potters. As yet nothing further has been established than that the varnish was not a "glaze" in the modern sense. A contributing factor to the final triumph of the monochrome over polychrome rested upon simple necessity. When naturalist motives became dominant in the painter's art, the lack of a green pigment left no satisfactory alternative to the general abandonment of variation in colour. In L.M. I, when the complete absorption of the polychrome into the monochrome style took place, we find a general use of a brilliantly lustrous brown-to-black "glaze" paint on a buff clay slip, carefully polished by hand on terra-cotta clay. The naturalism of plants and flowers now extends to sea-objects—fish, shells, weeds, rocks—and is marked by careful truth to life. A striking example of this style is the famous "octopus" vase found at Gournia.[1]

As the rise of Cretan civilisation had been faithfully reflected in pottery, so was its fall. One can trace in it the general decadence of Crete. In the eventful L.M. II period, which saw the final destruction of Knossos and the sudden end of Cretan greatness, the

[1] See Hawes, *loc. cit.*, pp. 126–7.

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pottery becomes stiff and grandiose. Plants and animals are rendered in a spiritless, conventionalised manner. Degeneration was rapid, and in L.M. III (which represented the last stage of Minoan culture) the potter held his brush quite still and let the spinning pot do the rest. There was no decoration beyond an occasional group of horizontal bands, the mere framework of earlier designs.

There were, of course, other forms of pottery besides vases. Cretan potters, even more than those of to-day, used clay as the material for hardware. Not only bricks, drain-pipes, ornaments, but lamps, kettles, even cupboards and tables, were made of clay.

(To be continued)

Correspondence

THE METEOROLOGICAL OFFICE AND THE AIR MINISTRY

To the Editor of DISCOVERY

SIR,

Mr. D. W. Horner, in his article on Modern Methods of Weather Forecasting in your September issue, mentions, with some approval, the placing of the Meteorological Office under the Air Ministry. Most independent meteorologists, and if truth were known most official meteorologists also, deplore the fact as little short of disastrous for the best interests of meteorology in this country. Only one side of meteorology appeals to the aviator, and its other sides are not likely to come off well when the finances of the Meteorological Office are controlled by the Air Ministry. The meetings of the Meteorological Committee are presided over by an officer in the Ministry who in general will not have had the scientific training to enable him to appreciate meteorological problems outside his own province. Officials in the Meteorological Office are now civil servants, and are debarred from taking part in any public discussion bearing on the work of the office. Even the *Meteorological Magazine*, which in former times, as *Symons's Meteorological Magazine*, used to publish abstracts of all papers read before the Royal Meteorological Society, cannot now publish such extracts if they criticise the work of the Office. The Office has been quietly taken over by the Air Ministry without any show of reason, and without any committee of inquiry such as there has always been in the past when there has been any change in the status of the Meteorological Office.

C. J. P. CAVE,

Captain late Meteorological Section R.E.

DITCHAM PARK,
PETERSFIELD.
September 7, 1920.

DOWSING

To the Editor of DISCOVERY

SIR,

I was interested in your remarks upon water-divining, or dowsing, as you call it, in the September number of DISCOVERY.

I know very little about dowsing, and certainly I have neither experience nor training in the matter to offer an opinion of any value on the subject, but I am inclined to agree with your view that there is no physical action between the water underground and the twig. How could there be? But I disagree with you in this: I do not think that dowsing is a problem for the psychical research people at all. It is a matter for the experimental psychologist.

My view is that some part of the dowser's mind knows in some way all the time the whereabouts of the thing sought for, and this carry-on of his with the twig of hazel in his hands is only (unconsciously, of course) a means of getting the subconscious part of his mind to communicate with the conscious.

There are probably lots of other ways of dowsing besides using a hazel-twig, and I believe that *anything at all* can be dowsed if the dowser's subconscious mind is set upon wanting it. Here is a thing that happened which seems to bear out this theory. While I was reading your remarks, it dawned upon me suddenly that there was a thing in my own home which I might with profit attempt to dowse. About three months ago, I lost or mislaid a bunch of keys, and search as I would, high or low, I could not find them. I think I must have sought everywhere for them. So I put down your paper, imagined myself a first-class dowser, and joining my hands, as a timid diver might on a cold day previous to his first plunge, began to dowse. In less than twenty seconds I found myself in a very dark pantry rummaging under an old linen overall. There I found a glass jar which in better days had contained chicken-and-ham paste, now filled with screw nails, and hidden in the nails were my keys. I seemed to get there without any let or hindrance, and certainly those keys were the very ones I had sought for in vain.

Of course, this may be entirely a coincidence. I am inclined to think not.

F. MORETON.

GLENAVY,
CO. ANTRIM,
September 8, 1920.

[This letter deals with an interesting experience. It has, however, nothing to do with dowsing, where the knowledge of the whereabouts of the thing sought cannot be in the mind of the dowser or of anyone with him.

Other letters on this subject have been received, for some of which we regret we have no space. Most of these letters deal exclusively with the marvellous things that dowsers have done and can do. What we really want to get at, however, is an explanation of the phenomena, and an account of experiments undertaken to test any hypothesis put forward.—ED.]

Reviews of Books

O. Henry. A Biography. By PROF. ALPHONSO SMITH. (Hodder & Stoughton, 10s. 6d.)

American writers, especially short-story writers, are wonderful people. See them in real life or in evening dress, and they are indistinguishable from dentists, architects, or University lecturers. Talk to them, and if they reply at all they will speak in soft, quiet, and melodious tones, with their straw hats pressed hard against their hearts. Visit them in the offices where they make their stories, and there they are dictating quietly to a prick-me-and-I-shall-bleed young gentleman at a typewriter. Invite them to visit you, and no men were ever so quiet, so polite, so well-behaved. It is only when the lamps of their lives have gone out, and the biographies have appeared, that you realise that unawares you were entertaining angels of a very special kind. You find that the pleasant man whom you imagined living a quiet life, taking a pass degree at Harvard, marrying a clergyman's daughter, and commencing authorship with a volume of poetry, was in reality somebody very different. He shone shoes at seven, dispensed drugs for his grandfather at sixteen, and never went to college at all, or, if he did, paid his way through by farming in the summer. By thirty he had ranched in Texas, cruised in the South Seas, visited Klondike, butted into one or two little wars, and bought land and settled down in Kansas City, Kansas. He could ride, swim, shoot, fish, hunt, and box, so he didn't see why he shouldn't write also. Story writing gave him just the scope for self-expression he required, so he married, took a trip round the world, lived in Boston, removed to 'Frisco, and finally settled down in Brooklyn and wrote. Alas! that at forty-five he died.

I do not wish to imply that the above is to be taken literally as applying to O. Henry, but he was a true member of the restless and adventurous breed that it describes; the men who have had a rich experience of the world, and who possess in addition the essential qualities of a good story-teller or of a good conversationalist—quickness, humour, a power of seeing connections, charm of manner, readiness and sympathy.

O. Henry was a pen-name. The real man was William Sydney Porter, a native of North Carolina, who was born in 1862, and who died in New York City in 1910. In early youth he gave up a post as chemist's assistant for ranching in Texas. After several years of that he did clerical work in various capacities in Texan cities, and in his spare time sent in jokes, poems, and stories of a humorous nature to the papers. The editors put them in and asked for more, indeed complained that he didn't send them enough. This is a complaint that many writers would like to hear more frequently, and it induced O. Henry to give up his clerical work for that of a reporter on the *Houstoun Daily Post* in 1895. The next year a calamity overtook him. He was ordered to go to Austin, the state capital, to stand trial for embezzling the funds of a bank in which some years previously he had been teller. He started off on this journey, but before he reached its end he changed his mind and his train, and

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travelled to New Orleans instead. Viewing this with the wisdom that comes after the event, we see it was a bad mistake. Like Conrad's Lord Jim, he made one fatal mistake at the supreme crisis of his life, a mistake from which he could never recover.

From New Orleans he sailed to Honduras with the intention of settling down somewhere in Central America, but after some months' sojourn in "that land of drowsy caliphs," he returned to Texas owing to the serious illness of his wife. The following year (1898—his wife had died in the meantime) he stood his trial and received a sentence of five years, which, by a process of multiplying by two and dividing by three, was subsequently reduced to three years and a few months. This period (1898–1901) was passed at Columbus, Ohio. This gaoling of O. Henry was a peculiar business. There seems to be no doubt in the minds of those who know the facts that O. Henry was innocent. He said so himself, and always maintained so. One of the charges preferred against him referred to a time when he had left the employment of the bank, but O. Henry, perhaps unwisely, refused to put up any kind of a defence at all.

In the gaol, of course, he got lots of copy. *The Gentle Grafter*, probably the best of his books, was worked up from material gleaned there, and one of his best stories, the story of the reformed burglar who gave away his former occupation by opening a safe to release a little girl who had accidentally shut herself in, was suggested by a story told him by a fellow-prisoner, who, although guilty of many crimes, was actually doing time for something he had never done. Life was made more tolerable also by the kindness of the prison doctor. This man gave O. Henry a job as drug clerk, and later recommended him for a post in which he was more a servant than a prisoner. One of the most enjoyable things in the book under review is the collection of letters that O. Henry wrote from prison to his motherless daughter. They were lively, humorous, affectionate, and care-free epistles, and there was no word in them which would lead his daughter to suspect that her separation from her father was due to his being in gaol.

In prison O. Henry commenced writing the short stories that were afterwards to bring him fame. In his previous journalistic work he had written under his real name, but a desire to break with the past on his release led him to adopt his *nom de guerre*. To conceal himself further he posted his contributions to a friend in New Orleans, who reposted them to the editors in New York. Most of his stories were accepted and paid for, and their publication attracted notice at once. On being released in 1901 he went to New York, and there began the great creative period of his life. He became a recluse. His New York friends did not know his past history. His friends in North Carolina and New Orleans did not identify the Will Porter of their experience with the O. Henry of New York, variously styled the American Kipling, the Y.M.C.A. Boccaccio, the Homer of the Tenderloin, and the twentieth-century Haroun Al-Raschid, until photographs appearing in the literary papers gave him away.

O. Henry wrote short stories only. At first these dealt with his experiences in Texas, the West, and Central America. Later, New York—the little village on Father Knickerbocker's farm with the shady lane running down the centre—became his principal theme. Of 115 stories written in 1904 and 1905, all but sixteen deal directly or indirectly with New York City. With one paper he had a contract for a story each week, and for this he received £20. Professor Smith thinks that were he writing now O. Henry would get about £200 a story. Whatever sum he might have received, his bank balance would not have been great. He did not believe in treasuring up the things of this world. Money passed through his hands like water through a sieve. He initiated a system of giving tips to waiters which were twice as large as the bill itself. Frequently he got down to his last dollar, but this he was always ready to share. He gave away to the poor clothes that he needed himself, and, like a real Christian, even asked the beggars to call again.

Professor Smith says that if ever the man and the place met, it was when O. Henry strolled for the first time along the streets of New York. In a letter to his (second) wife O. Henry writes: "I could look at these mountains a hundred years and never get an idea, but just one block down town and I catch a sentence, see something in a face—and I've got my story." New York, and the people in it, and all about them, were the things he loved and the things he could describe best. *The Voice of the City* and *The Four Million*, which deal with New York, contain the finest short stories since the days of Hawthorne and Bret Harte.

"In the Big City large and sudden things happen. You round a corner and thrust the rib of your umbrella into the eye of your old friend from Kootenai Falls. You stroll out to pluck a sweet-william in the park—and lo! bandits attack you—you are ambulanced to the hospital—you marry your nurse; are divorced—stand in the bread line—marry an heiress—take out your laundry and pay your club dues—seemingly all in the wink of an eye. You travel the streets, and a finger beckons to you, a handkerchief is dropped for you, a brick is dropped upon you, the elevator-cable or your bank breaks, a table d'hôte or your wife disagrees with you, and Fate tosses you about like cork crumbs in wine opened by an untipped waiter. The City is a sprightly youngster, and you are red paint upon its toy, and you get licked off."

He died as he had lived, happy, easy-going, optimistic, with the catchwords of the street and the refrain of a music-hall song on his lips. "Turn up the lights," he said. "I don't want to go home in the dark."

A. S. R.

Other Books Received

The Psychology of Dreams. By Dr. Wm. S. Welch. (Kegan Paul, 12*s.* 6*d.*)

The History of Social Development. By Dr. F. Muller-Lyer. Translated by E. C. and H. A. Lake. (George Allen & Unwin, 18*s.* net.)